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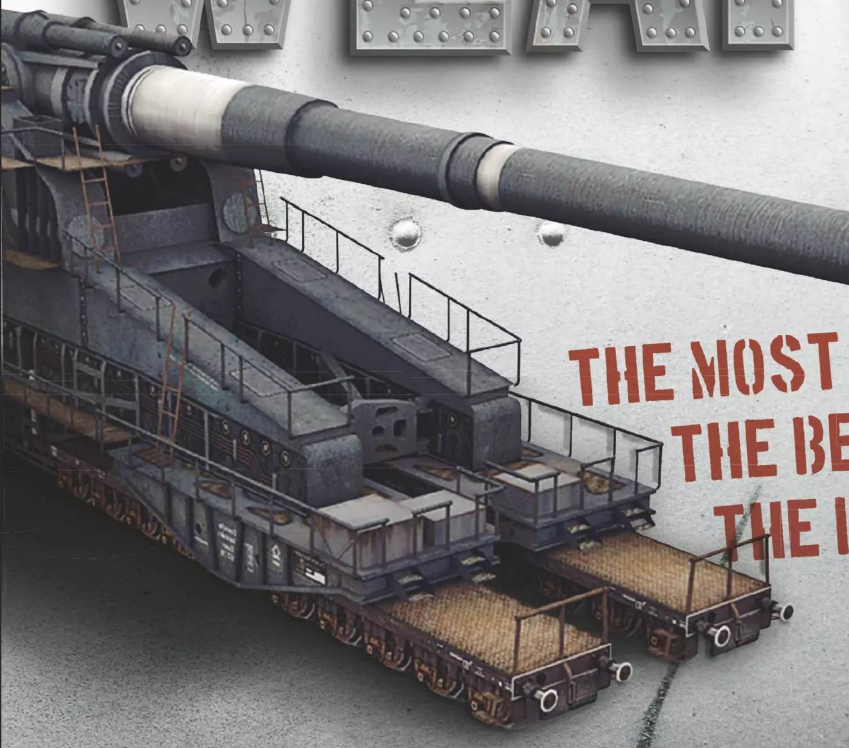

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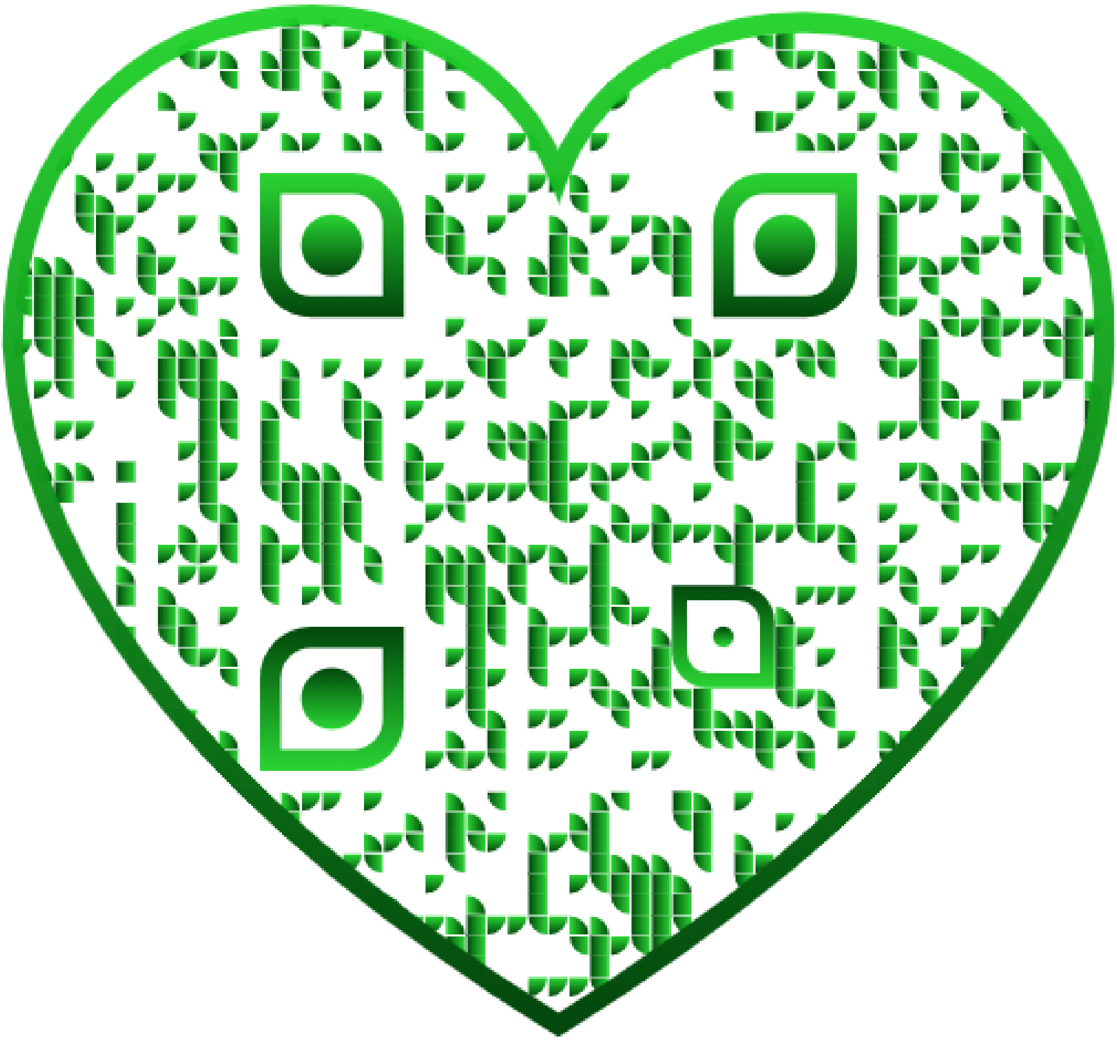

WWII's most savage weapons

When World War II broke out, Adolf Hitler had the most modern war machine at his disposal. Since seizing power in 1933 with seductive promises of peace, order and the restoration of the Greater German Reich, he had rearmed and forged alliances. Poland was the first to succumb to the massive Panzer units that surged forward, while the Luftwaffe effectively smashed enemy bastions and destroyed bridges, roads and radio stations. The Blitzkrieg rolled across Europe, and before long Hitler set his eyes on Britain, which was next in line to be defeated by the world's most powerful air force. But the British had a trump card in the form of the nimble Spitfire, which managed to see off the Germans' stronger Messerschmitt fighter.

But the Führer would stop at nothing to defeat his foes, and time and again the Germans developed devastating new weapons. Many designs made it beyond the drawing board – huge tanks, invisible aircraft and supersonic rockets, but thankfully Hitler's scientists never delivered him an atomic bomb. In this special issue, read all about these and other weapons from WWII.

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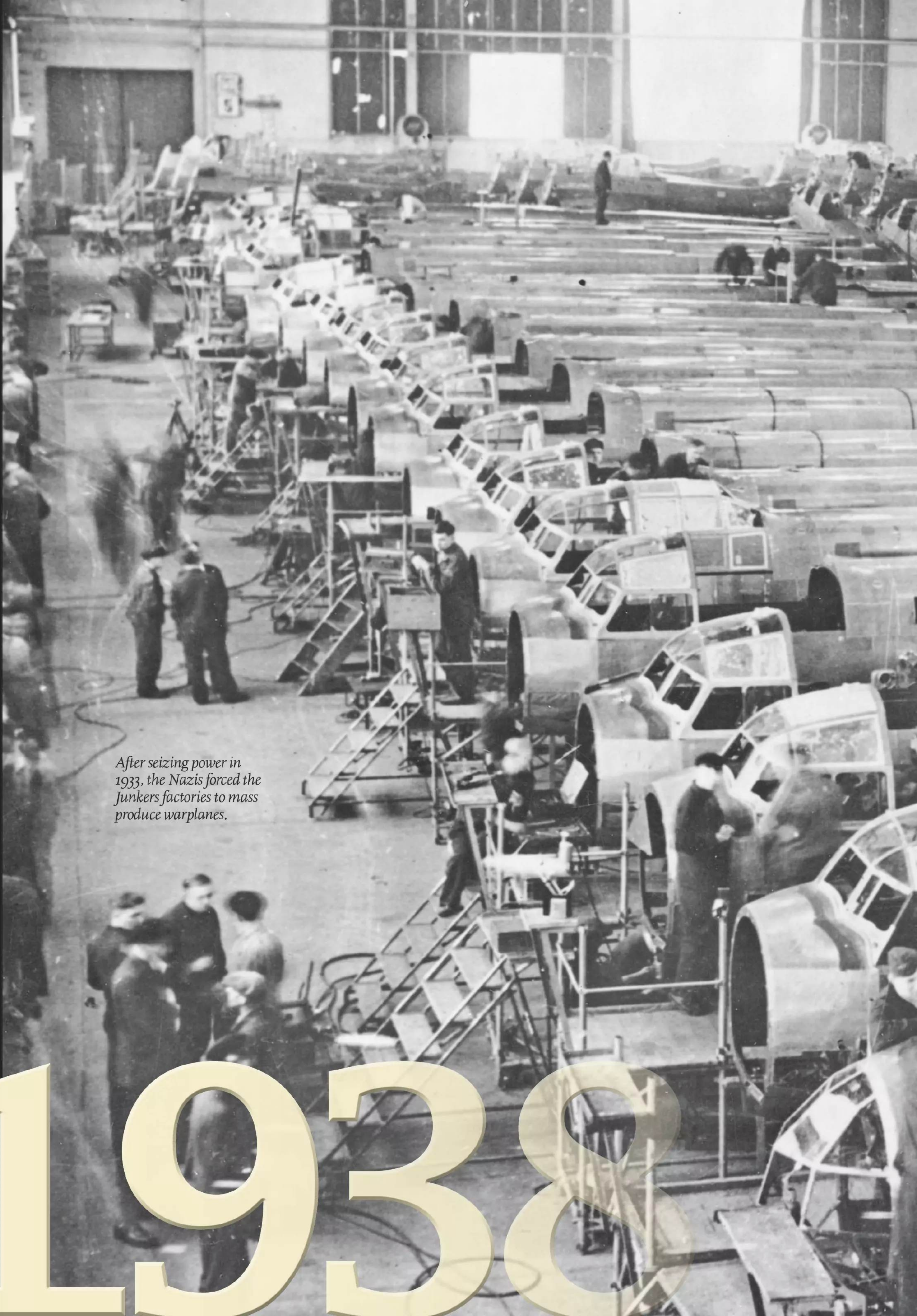


After seizing power in 1933, the Nazis forced the Junkers factories to mass produce warplanes.

1938

GERMANY TAKES THE LEAD IN PRE-WAR ARMS RACE

After World War I, Germany was prohibited from rearming. But that didn't concern Adolf Hitler in the slightest. The Nazi leader had barely gained power in 1933 before he began to mobilise factories, and very quickly began rolling out state-of-the-art weapons. Six years later, Germany had developed the world's strongest war machine.

Europe, 1938

THE STAGE IS SET

As soon as Hitler assumes power in 1933, he embarks on his mission to transform Germany into a thoroughly militarised and strong country. Drawing on his experiences in World War I, the new dictator plans to create a powerful air force. He has a cunning ploy to bypass restrictions from the Treaty of Versailles.

At Berghof, Adolf Hitler's private residence in Bavaria, the view from the specially installed panorama window in the Great Hall was like a postcard: green grass and blueish mountain peaks stretched as far as the eye could see. The beautiful view matched the dictator's mood that day. Hitler was relaxed as he met with 50 top-ranking officers in the high-ceilinged room on 22nd August, 1939. The time had come for war, and he said the prospects were good. France and Britian were militarily weak, while Germany was ready. "When starting and waging a war," Hitler announced, "it is not right that matters, but victory... The stronger man is right."

The officers were accustomed to Hitler's bombastic style, but this time the dictator had reason to be exremely confident. Germany was the strongest state in Europe. Since coming to power six years earlier, he'd rearmed intensively. Modernisations, investments and focused training had fine-tuned the German Wehrmacht's commanders and men. As the summer of 1939 drew to a close, Hitler made it known he had the world's most modern war machine, and the other European powers looked on tentatively.

Germany's superiority was paradoxical. 20 years earlier, World War I had left the defeated country impoverished and humiliated. Determined that the so-called "Great War" would be the last major conflict, the victorious powers behind the peace settlement imposed stringent demands for Germany to disarm. The size of both her army and navy were limited. Never again would a militarised Germany threaten the peace of Europe.

Hitler dismissed the treaty

Hitler was of a different opinion. He had already denounced the Treaty of Versailles in *Mein Kampf* in 1924. "The Versailles Treaty is worthless. 60 million German hearts and minds are on fire with anger and shame. They will cry out, 'We want war!'" Neither did Hitler bother to conceal that under his leadership Germany did not intend to respect the borders of her neighbours for long: "It will be the duty of German foreign

Tank drivers competed to break through walls, here at a so-called "Panzer Sport Fest" at Wünsdorf in 1936.

NAME **THE GÜNTER BROTHERS**

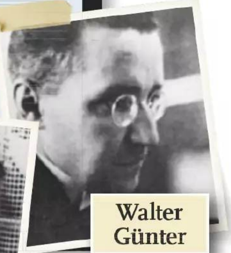
TITLE AIRCRAFT DESIGNERS

Born in 1899

Twin brothers lifted the Luftwaffe

As 10-year-olds, twin brothers Siegfried and Walter Günter heard about the French pioneer Louis Blériot's flight over the English Channel. The event sparked a lifelong interest in aircraft, and as designers, Siegfried and Walter created new aircraft types with aerodynamic hulls and elliptical wings. The planes had exactly the features that the Luftwaffe demanded, and the twins' design played a major role in the many German successes in the air.

- **Walter died in 1937.**
- **Siegfried died in 1969.**


Walter Günter

Siegfried Günter

policy to get large spaces to feed and house the growing population of Germany. Destiny points us towards Russia," he stated in *Mein Kampf*.

When Hitler took power in 1933, his first move was to establish a strong air force. This choice was no coincidence. German aircraft technology had been at the head during World War I, both in terms of innovative technology and efficient production. Among the Germans' many advancements were aircraft structures made almost entirely from metal – other nations still primarily used timber into the 1940s. German aircraft also had cantilevered wings and forward-facing, synchronous guns.

The Treaty of Versailles was not an immediate obstacle to the development of the Luftwaffe, because it was filled with loopholes. For example, the Treaty did not prohibit German pilots from training abroad, nor did it apply to civil aviation. In fact, for several years during the democratically elected Weimar Republic, Germany had been sending young men to train as pilots in the Soviet Union. At the same time, gliding clubs – where young people could prepare for a career in the air force – grew in popularity across the whole of Germany.

For Hitler, these tentative measures weren't enough. In 1933 he instructed aircraft manufacturers to build 1,000 new planes. The factories were given strict orders to construct the aircraft in such a way that they could also be used for civil aviation to stay within the provisions of the Versailles Treaty. One of these new flying wonders was the Heinkel HE 111, launched in 1935.

FACTS

TREATMENT WAS HARSH

After World War I, the Allied victors imposed strict restrictions on Germany, especially in respect to its army.

- **The number of soldiers could not exceed 100,000 and conscription was banned.**
- **Tanks and other assault weapons, naval vessels over 10,000 tonnes and submarines were prohibited.**
- **Areas of land, including the region of Alsace-Lorraine at the French border, were abandoned.**
- **German colonies were mandated under the League of Nations.**
- **The country had to pay significantly large war reparations.**

PROTESTS WERE VAGUE

In addition to expanding the air force, Hitler also tripled the size of the army from the 100,000 men permitted by the Treaty of Versailles to 300,000. He also contravened it with the order to construct new tanks. In February 1935, Germany secretly formed its first armoured brigade, at which point Hitler believed his military buildup was so far advanced he could reveal his true intentions to the world.

In March 1935, he announced – at first discreetly via Göring to a British official and then publicly – that Germany possessed an air force of 2,500 aircraft, most of which were newly built and state-of-the-art. Hitler also claimed that he was planning to expand the army to over 550,000 men.

This blatant and public violation of the treaty that had formed the basis of peace and order in post-war Europe was allowed to go almost unchallenged. Apart from a few diplomatic objections, neither Britain nor France lifted a finger. On the contrary, the British came to the Germans' assistance in June 1935 – just three months after Hitler's announcement – by signing the Anglo-German Naval Agreement, which extended the scope for German expansion. The agreement gave Germany the opportunity to build a submarine force of equivalent size to the British and a surface fleet one third the size of the Royal Navy.

BRITAIN COULD NOT AFFORD WAR

Britain and France's lack of condemnation seems like a submissive stance to the Nazi regime's militarisation. But from the point of view of the two countries, the reaction – or lack of – was simply common sense. Both Britain and France were terrified at the thought of a new war. World War I had been hard on both countries, militarily, economically and in terms of lives lost.

Economically, Great Britain had been most hard-hit. German submarines had cost Britain 40 percent of its merchant fleet, and to finance the war, Britain had been forced to dispose of most of its foreign assets. The result was soaring import duties and an unemployment rate of nearly three million people at its peak in 1931, over 20 percent of the workforce.

This lack of money clearly showed in the country's military arsenal. The Royal Air Force was still made up of biplanes, a throwback to the previous war and hopelessly outmoded. The Royal Navy, pride of Britain and the lifeblood of the vast empire was not in much better shape. In the early 1930s, Britain possessed so few ships that the chiefs of staff were not sure that any of the country's many bases were properly equipped to withstand an attack. Britain's lack of a reckonable military force meant that the country had to turn a blind eye to the Germans behaviour and remain on good terms.

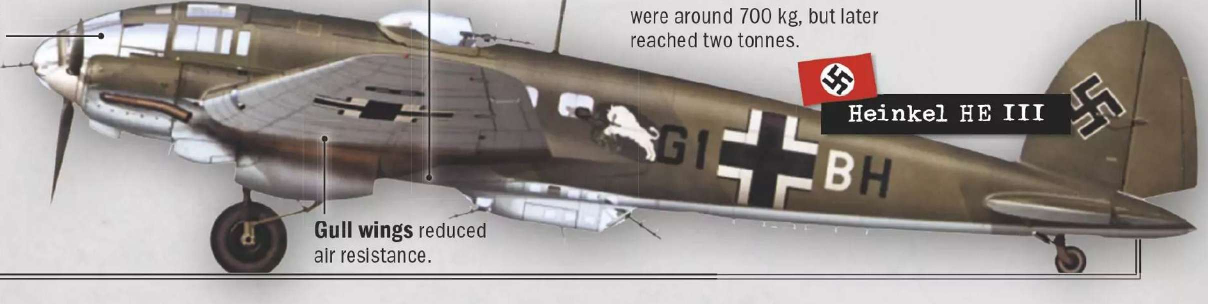
Although Germany continued to rearm at breakneck speed, the British still committed only extremely limited funds to their military budget. Even

Hitler forced Europe to rearm

Poverty and crisis in the interwar period impacted military budgets, which were sharply cut in most countries. But Hitler's rearmament forced neighbouring countries to acquire new weaponry, and a number of new innovations were launched in the 1930s.

Air support determined the success of the army

Superiority in the air was absolutely crucial for success on land. The lessons had been learnt before World War II, and both sides made great efforts to develop the best and fastest aircraft. One of the most effective was the German Heinkel HE 111, described as a wolf in sheep's clothing: the machine was made to look like a transport aircraft to sidestep the Treaty of Versailles, which banned the Germans from having warplanes, but it was actually a **bomber**. The HE 111 spread terror on all fronts in Europe during the war. Although its manoeuvrability was not impressive, the plane's **solid hull** could absorb considerable damage.



The cockpit was built completely from glass to give pilots a good view at all angles.

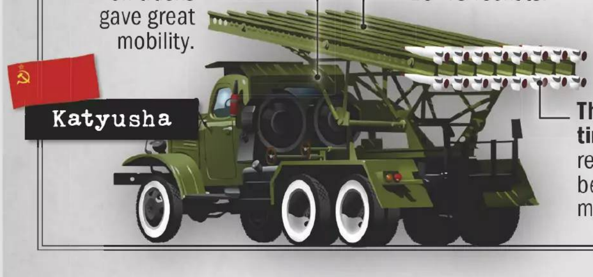
Bomb loads in the first models were around 700 kg, but later reached two tonnes.

Gull wings reduced air resistance.

Organ played death music

With the development of a new rocket launcher system, the Russians had an effective response to German tanks. Multiple **gun barrels** allowed the launcher to fire a number of rockets quickly. And thanks to its **simple design**, the weapon was quick and inexpensive to produce.

In Russian, the system was named Katyusha after a popular song about a girl who misses her soldier lover who is at the front. The Germans nicknamed it "Stalin's Organ".



The simple construction on trucks gave great mobility.

The launch array had a total launch capacity of 16-48 rockets.

The loading time was relatively long because of the many tubes.

Submarines were feared in the oceans

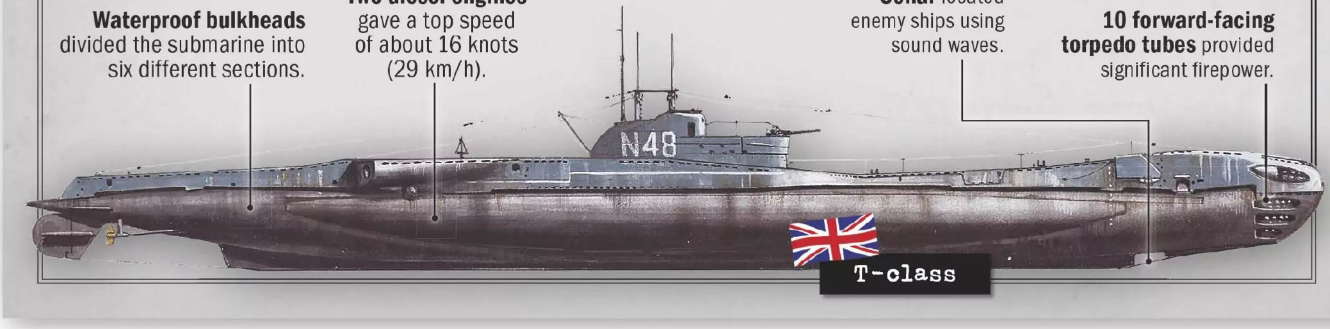
During the war, the British gradually succeeded in breaking the German dominance under the sea's surface, not least thanks to their T-class submarines. The vessels were equipped with **10 forward-facing torpedo tubes**, which made it difficult for opponents to evade. The T-class also had a modern **ASDIC sonar** system and was able to dive down to depths of around 90 metres. These submarines were given names beginning with T, with *HMS Triton*, launched in 1937, being the first.

Waterproof bulkheads divided the submarine into six different sections.

Two diesel engines gave a top speed of about 16 knots (29 km/h).

Sonar located enemy ships using sound waves.

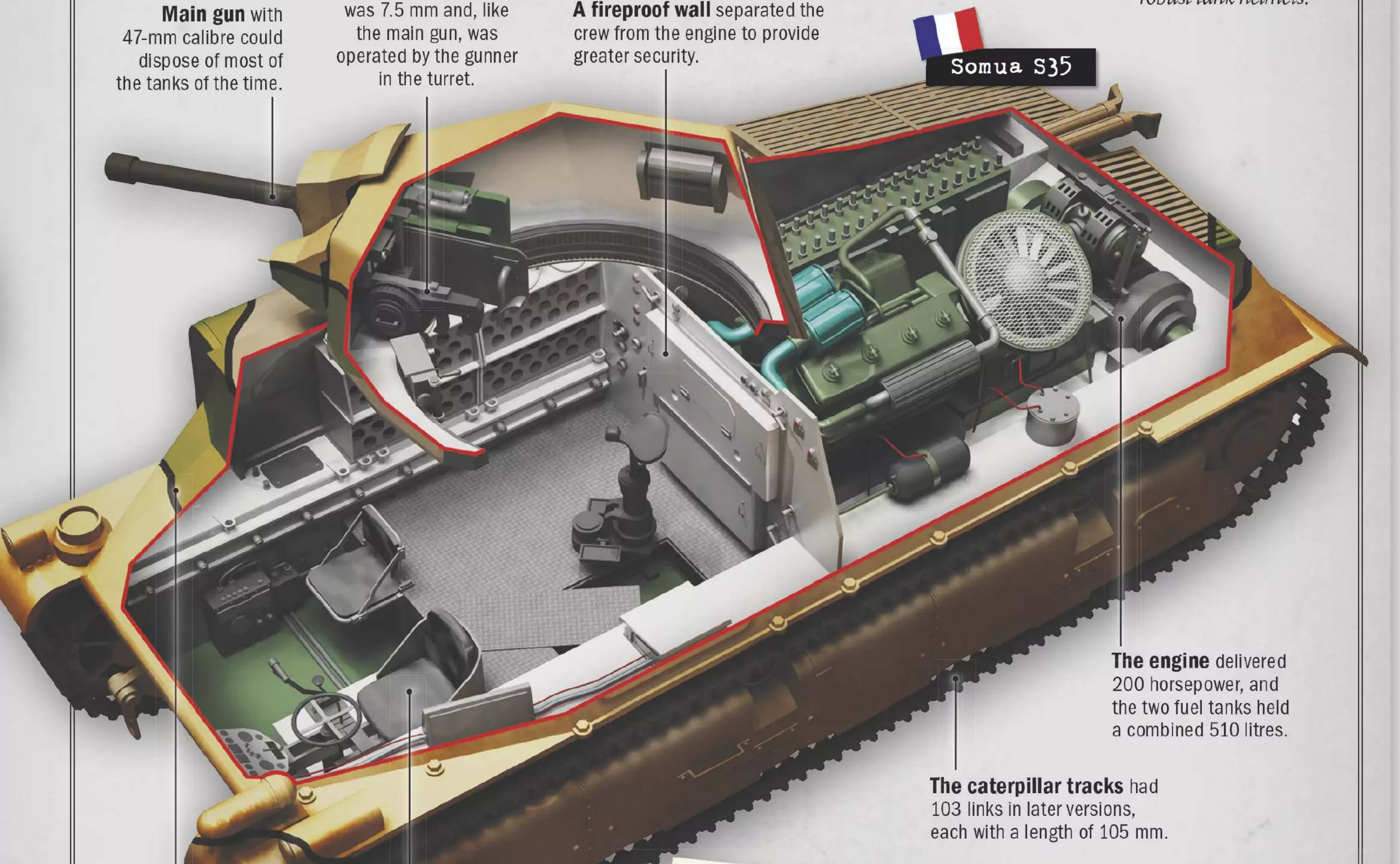
10 forward-facing torpedo tubes provided significant firepower.



Tanks became effective killing machines

During World War I, **tanks** were slow and clumsy debutants on the battlefield, but during the interwar period, the combat vehicles evolved with faster top speeds, better armour and more powerful guns. At the same time, they became more reliable – in particular the caterpillar tracks, which had been a weak point. The manoeuvrable Somua S35 played an important role for the French during the German invasion of 1940, although many vehicles were allocated to infantry divisions and weren't used effectively as armoured units.

There were around 430 Somua S35 tanks, and their crews typically wore robust tank helmets.



Main gun with 47-mm calibre could dispose of most of the tanks of the time.

The machine gun was 7.5 mm and, like the main gun, was operated by the gunner in the turret.

A fireproof wall separated the crew from the engine to provide greater security.

The engine delivered 200 horsepower, and the two fuel tanks held a combined 510 litres.

The caterpillar tracks had 103 links in later versions, each with a length of 105 mm.

Sloping armour all the way around caused enemy shells to bounce off.

The crew consisted of three men: a driver, a commander/gunner and a radio operator.

The Germans captured many French S35s and used them in their own army.

The so-called "Stalin's Organ" could easily be transported on trucks and became one of the most effective Soviet weapons. Here, in action in Hungary.

in 1938, the cost of defence accounted for only seven percent of Britain's GDP. The money was widely used to modernise the navy, which was most important in terms of guarding Britain's global empire. In addition to new battleships and a series of aircraft carriers, the British also acquired new submarines. The T-class submarines were so large that they could independently patrol the globe and protect important Asian territories like India, Singapore and Hong Kong. Britain's own defences were in the hands of an obsolete air force and a hard-pressed fleet.

FRENCH HID BEHIND A FORTIFIED WALL

The French regarded the Germans' rearming with concern, but without surprise. France had good reason to fear a repetition of the Great War. The overwhelming majority of the war had been on French or Belgian soil, and the French had paid a high price. The country had lost between 1.4-1.7 million young men from a population of around 40 million.

Both military and civilian leaders agreed: future fighting on French soil had to be prevented, almost at any cost. The French therefore literally chose to close off the country from Germany with a physical line of defence. Work on the defensive line, named the Maginot Line after its greatest advocate, Minister of War (and former war veteran) André Maginot, was started in 1930.

> **"This is not peace – it is an armistice for 20 years"**
>
> Ferdinand Foch, French Marshal, on the Treaty of Versailles

The Line was – almost symbolically – built on the remains of old trenches from Verdun. Along some sections, steep slopes formed a natural defence, but it was largely a complicated system of interconnected bunkers. Of these, 22 were underground fortifications, each with room for 1,000 men, while 36 were smaller forts. The Line was also supplied by electric railroad tracks that could bring weapons, equipment and supplies. Telephone cables were embedded into the cement, and the stores were protected by 17-tonne metal doors that closed automatically in the event of an explosion.

In the 1930s France started producing a range of tanks to guard the Maginot Line. Among the most advanced of these was the Somua S35, a manoeuvrable state-of-the-art cavalry tank. Only a few questioned the strategy, but some officers dared to express scepticism. Among them was Lieutenant Colonel Charles de Gaulle, a prominent advocate for army modernisation, who later was to become general and president. De Gaulle considered the idea of hiding behind a wall protected by tanks both dangerous and naive. Far better, the French should use the tanks to – collectively in small, fast units – seek out and face the enemy.

His words fell on deaf ears. The construction of the Maginot Line had cost seven billion francs, and the defence budget was virtually spent. At the same time, France's peaceful intentions were seen as a safeguard against attacks: "How can anyone believe that we are still thinking of an offensive, when we have spent billions on setting up a fortified barrier?" asked Minister of War, General Joseph Maurin.

STALIN DESTROYED HIS OWN DEFENCES

France and Britain's limited military strengthening meant that, in the autumn of 1939, only one country had enough weapons and soldiers to act as a counterweight to Hitler's war machine. From the early 1930s, the Soviet Union had rearmed steadily. Moscow didn't see Germany as a threat, however, but looked eastward to Japan, which in 1931 had invaded and occupied neighbouring Manchuria, a region in northern China in which the Soviet Union had strong interests. Fear of Japanese expansion had seen Stalin increase weapons production. In 1932, 4,000 tanks rolled out of the factories.

The Soviet Polikarpov I-16 aircraft was revolutionary, with landing wheels that could be pulled up when the machine was in the air. In the late 1930s, 'Stalin's organ', the Katyusha rocket launcher, was developed, but by the mid-1930s the Soviets were already ahead of their time in many aspects of weapons development.

In 1936, however, Stalin decided to remove all military commanders that he suspected of being rivals. These purges particularly affected the most talented and innovative officers, and afterwards the Red Army was left without the skills needed to understand, develop and use these new weapons. Hitler had free rein.

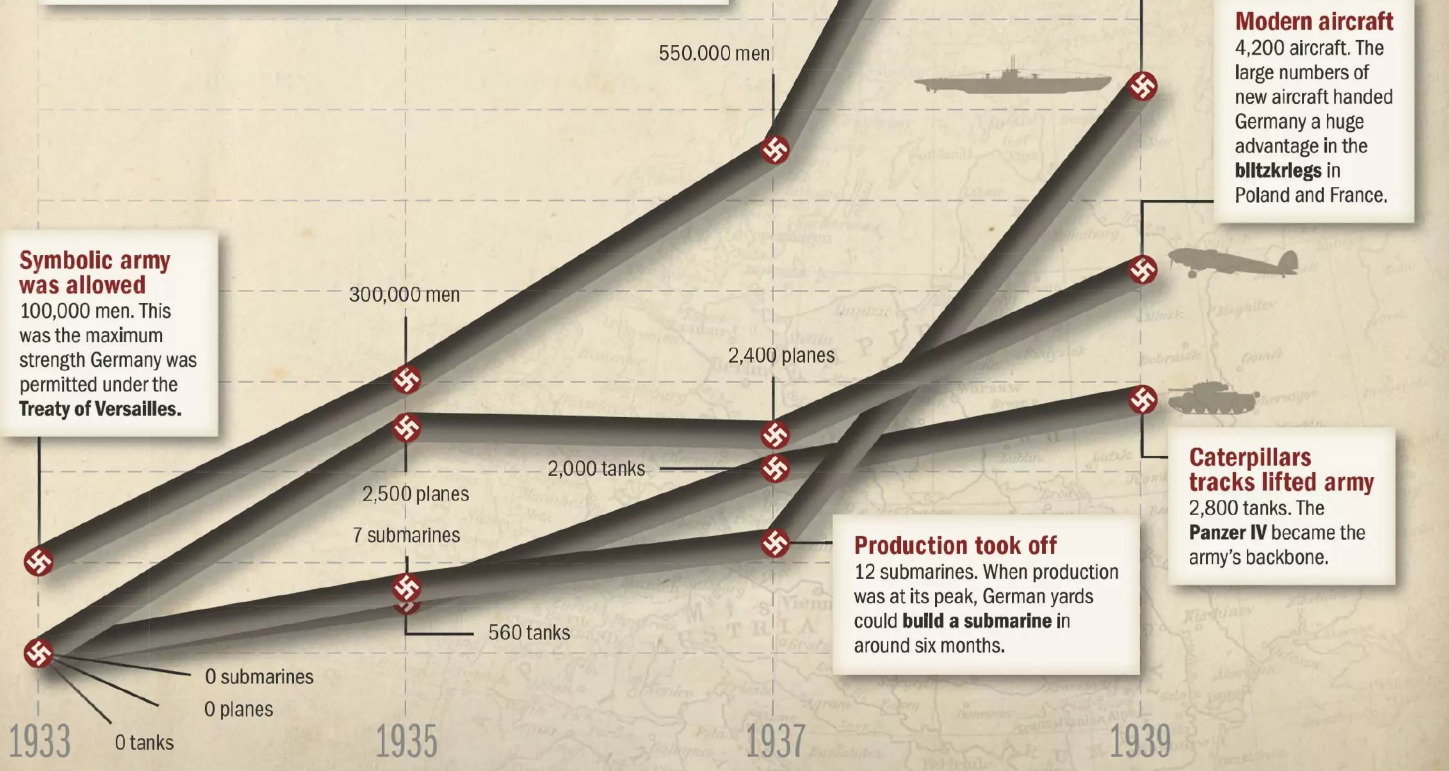
German weapons covered land, air and water

Initially, Hitler pretended that Germany remained within the Treaty of Versailles, but it soon became clear he had no intention of complying with any restrictions. Within a few years, German weapon production rocketed.

Businesses keenly participated

The German **Krupp factories** were forced to stop the production of weapons after World War I. But work resumed in earnest in 1933 as its owner seized the opportunity to deliver to an affluent customer.

Almost all German artillery and many tanks were produced by Krupp.



Symbolic army was allowed

100,000 men. This was the maximum strength Germany was permitted under the **Treaty of Versailles.**

Production took off

12 submarines. When production was at its peak, German yards could **build a submarine** in around six months.

Army numbered one million

1,300,000 men were **in uniform** at the outbreak of war, this was in addition to several paramilitary corps.

U-boats hunted in packs

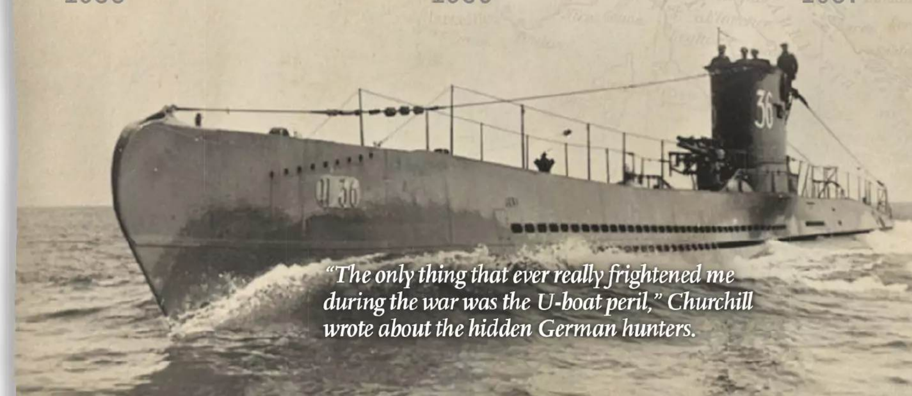
62 submarines. Kriegsmarine commanders organised the U-boats into **wolfpacks.**

Modern aircraft

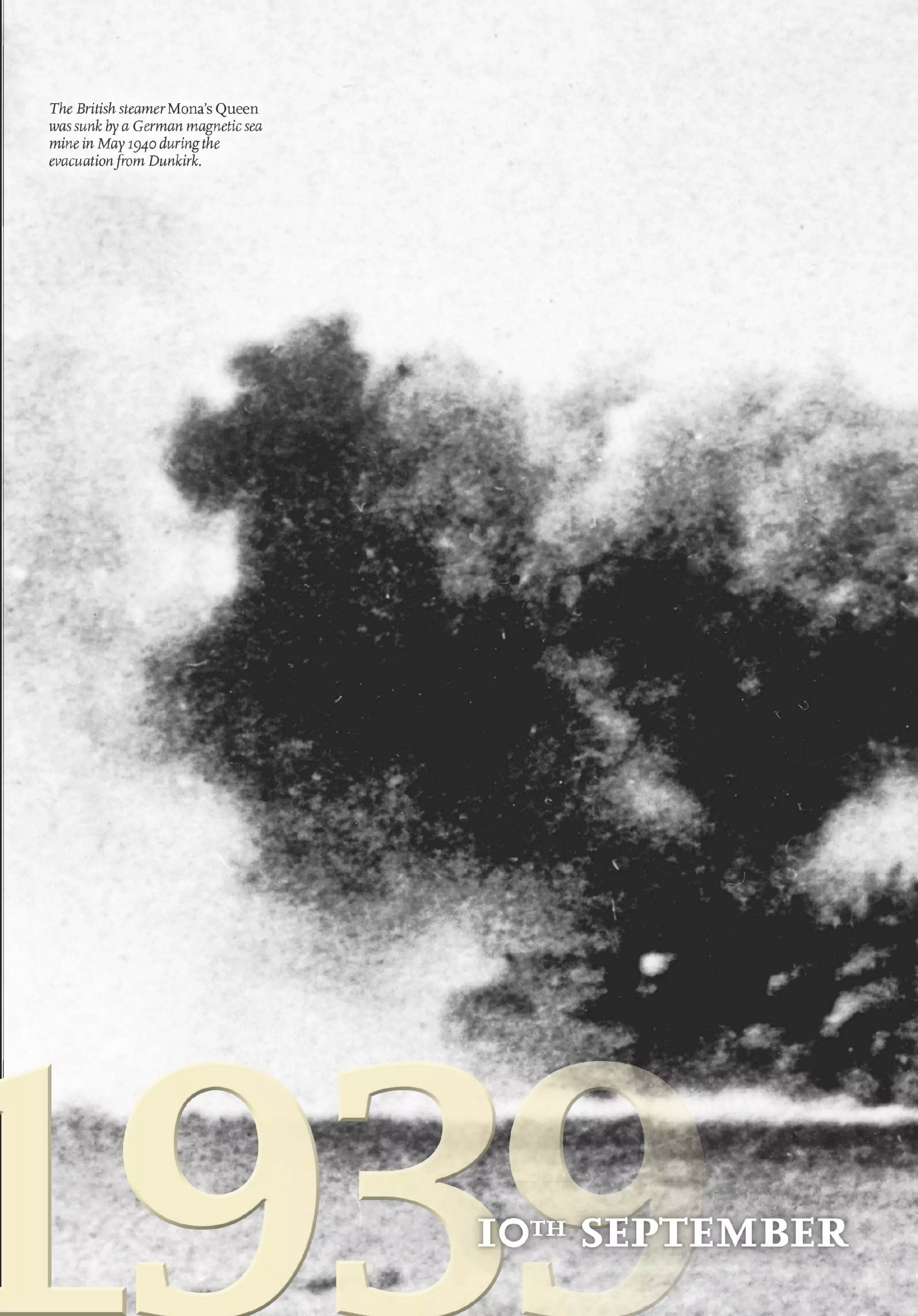
4,200 aircraft. The large numbers of new aircraft handed Germany a huge advantage in the **blitzkriegs** in Poland and France.

Caterpillars tracks lifted army

2,800 tanks. The **Panzer IV** became the army's backbone.



"The only thing that ever really frightened me during the war was the U-boat peril," Churchill wrote about the hidden German hunters.



The British steamer Mona's Queen *was sunk by a German magnetic sea mine in May 1940 during the evacuation from Dunkirk.*

1939

10th SEPTEMBER

TREACHEROUS MINE CONFUSES BRITISH

In 1939 British ships mysteriously begin to sink in waters supposedly clear of mines. Churchill gives orders to find out what the Germans are up to. And a dark November evening proves lucky for the British.

Great Britain, 1939

THE STAGE IS SET

GREAT BRITAIN

The war has just begun, and the British are working to improve an old weapon – a mine that works by means of magnetism. But the Germans have had the same idea, and the Nazis are ahead of their enemy. At the outbreak of war they have assembled an arsenal of magnetic mines, which are used immediately.

THE INK ON THE WAR DECLARATION TO THE GERMAN GOVERNMENT WAS barely dry before the German fleet began to lay mines. Efforts were made during the first months to protect the homeland and block the waters off the ports on Britain's East Coast using mines deployed by surface vessels and submarines. But something new was also tried: magnetic mines dropped from aircraft.

In September, October and November 1939, the Germans deployed 500 of these newly developed mines. And it wasn't long before the mines snared their first victim. The British steamer *Magdepur* was struck and sank off the British coast on 10th September – only seven days after the outbreak of war. Six days later, the *City of Paris* came too close to a German mine, but made it to port.

As the weeks passed, there were more explosions, and the new mines gradually inflicted more losses than those from submarines. Among the British fleet, everyone was wondering what caused the blasts in waters that had supposedly been cleared of mines, and the intrigue deepened among politicians as well as in the admiralty. When the intelligence service received reports from captured German seamen that Germany had been releasing magnetic mines, the British put two and two together. Hitler had a new secret weapon, and the admiralty surmised that the weapon was a new type of mine.

HMS Vernon was sunk by the German Navy, Joseph Goebbels announced to the amusement of the British. HMS Vernon was not a ship, but a land-based mining unit.

The challenge now was to find out how the mines worked and – above all – how to render them harmless.

GERMANS DEVELOPED SENSITIVE SYSTEM

Magnetic mines were familiar to the British fleet. During WWI, the British had invented and put into commission 500 magnetic mines off the Belgian coast. However, the electromagnetic triggering system didn't work very well, so in 1918, the British put the project on hold.

It wasn't until the mid-1930s, when the situation began to deteriorate, and Nazi countries started behaving increasingly aggressively, that the

Magnetic mine

Length	2.1 metres
Diameter	66.6 centimetres
Weight	540 kg
Warhead	300 kg

GIANT BOMB LAY ON THE SEABED

The German magnetic mine was not magnetic in itself, but exploited the fact that metal ships produced a magnetic field. The field from a passing ship triggered a magnetic needle in the mine, which lay on the seabed, to connect an electrical circuit that detonated it.

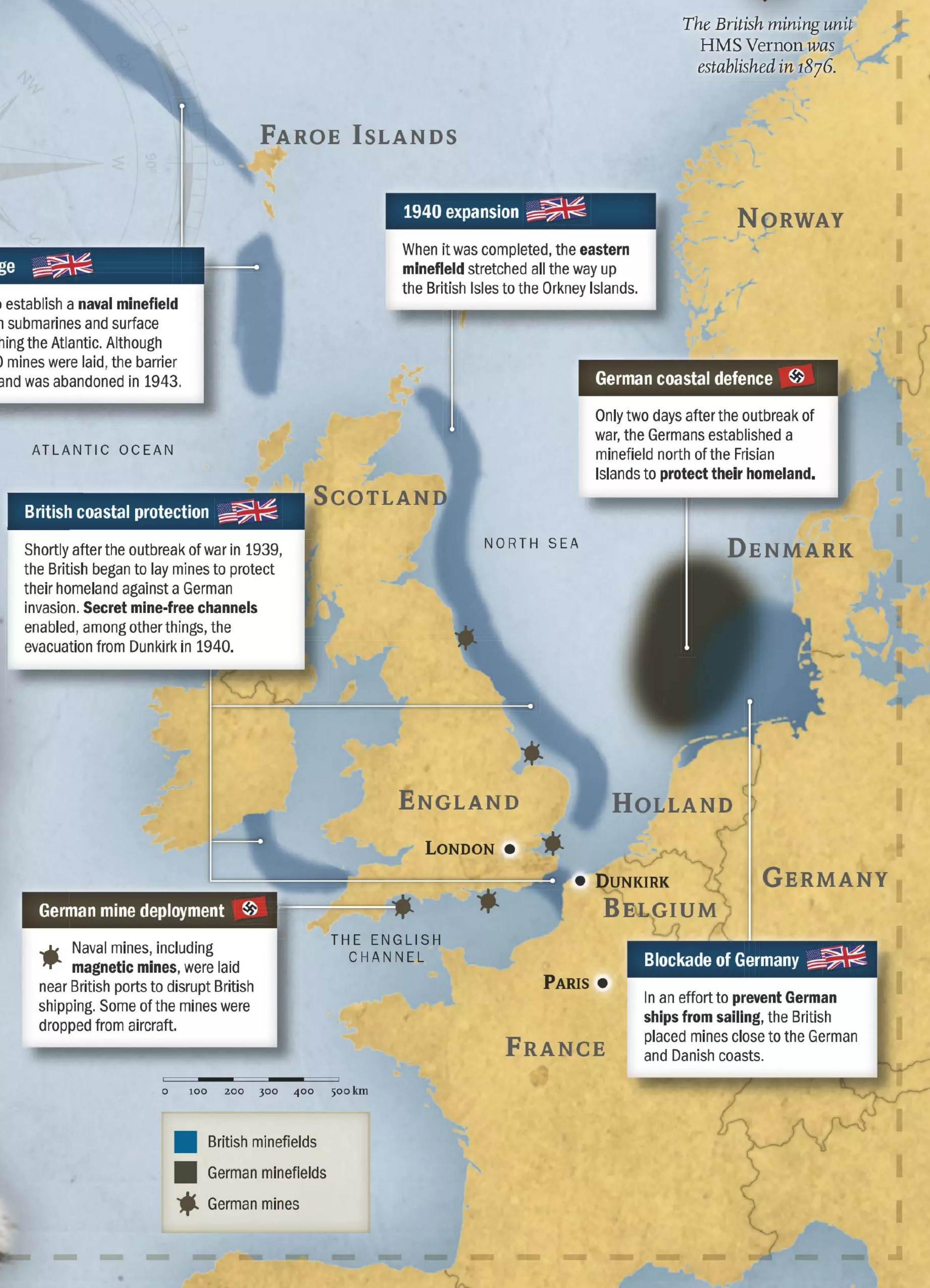
A copy of the mine, which the British rendered harmless, is today exhibited on the museum ship *HMS Belfast* in London.

After being disarmed, magnetic mines could be recovered and examined by British experts.

Minefields supposedly protected against enemy invasion

Both Britain and Germany established mine fields to guard against invasion and stop enemy ships. Most of the fields consisted of traditional mines, but the Germans had a trump card up their sleeve that could be laid close to British ports.

The British mining unit HMS Vernon *was established in 1876.*


ICELAND
FAROE ISLANDS
NORWAY
ATLANTIC OCEAN
SCOTLAND
NORTH SEA
DENMARK
ENGLAND
HOLLAND
LONDON
DUNKIRK
BELGIUM
GERMANY
THE ENGLISH CHANNEL
PARIS
FRANCE
0 100 200 300 400 500 km

Northern Barrage

The British tried to establish a **naval minefield** to prevent German submarines and surface vessels from reaching the Atlantic. Although more than 90,000 mines were laid, the barrier was not effective and was abandoned in 1943.

1940 expansion

When it was completed, the **eastern minefield** stretched all the way up the British Isles to the Orkney Islands.

German coastal defence

Only two days after the outbreak of war, the Germans established a minefield north of the Frisian Islands to **protect their homeland.**

British coastal protection

Shortly after the outbreak of war in 1939, the British began to lay mines to protect their homeland against a German invasion. **Secret mine-free channels** enabled, among other things, the evacuation from Dunkirk in 1940.

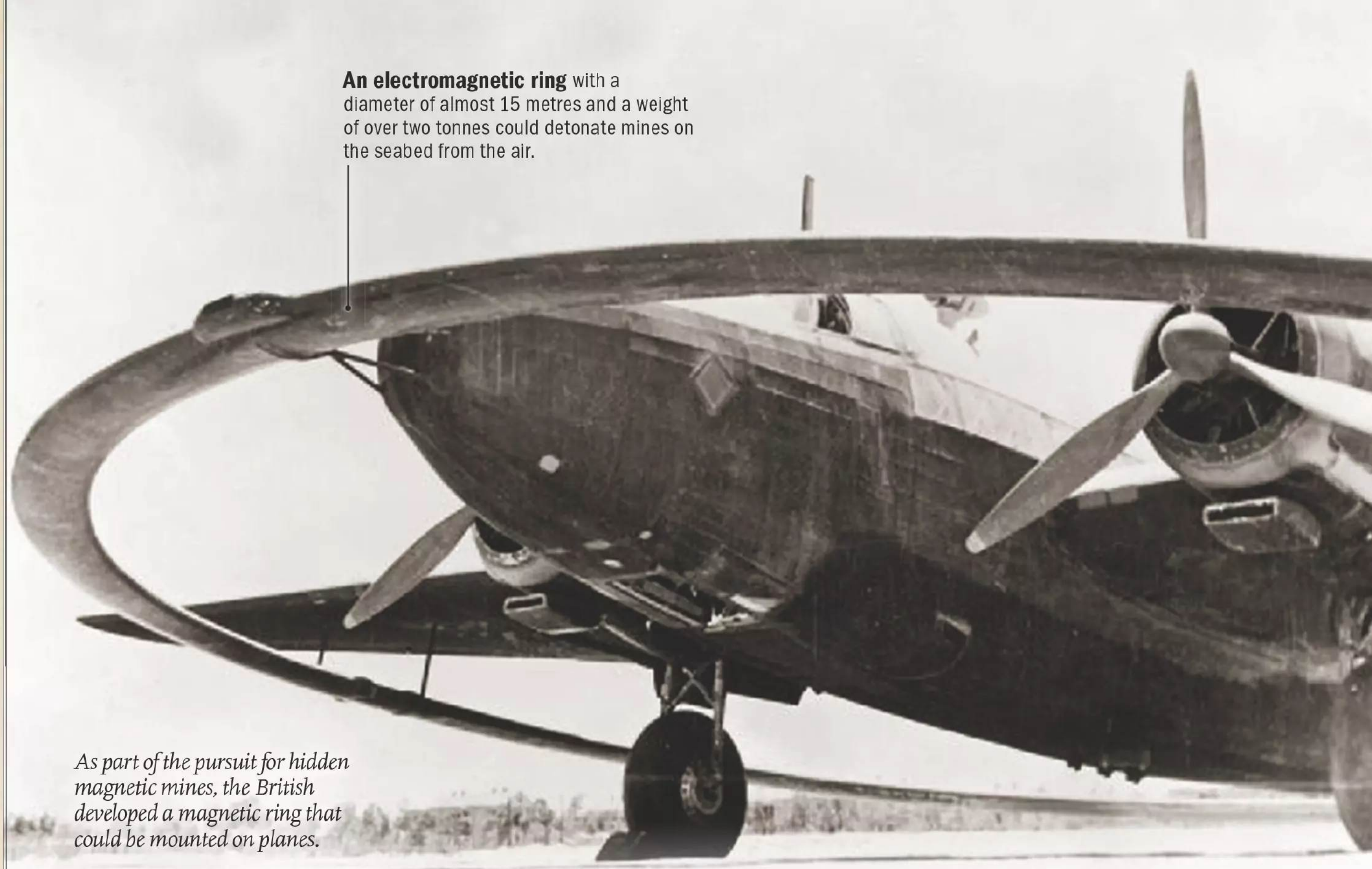
German mine deployment

✹ Naval mines, including **magnetic mines**, were laid near British ports to disrupt British shipping. Some of the mines were dropped from aircraft.

Blockade of Germany

In an effort to **prevent German ships from sailing**, the British placed mines close to the German and Danish coasts.

- 🟦 British minefields
- ⬛ German minefields
- ✹ German mines



An electromagnetic ring with a diameter of almost 15 metres and a weight of over two tonnes could detonate mines on the seabed from the air.

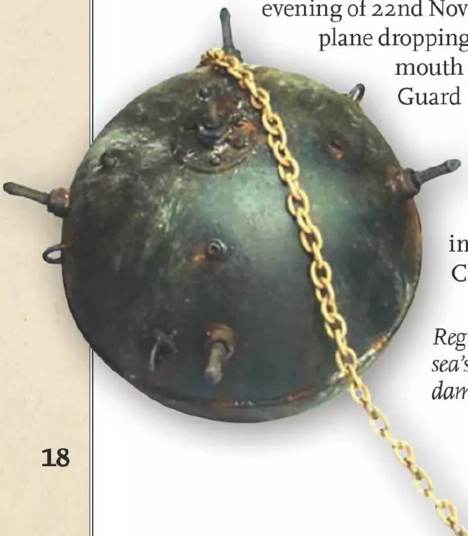
As part of the pursuit for hidden magnetic mines, the British developed a magnetic ring that could be mounted on planes.

British resumed development. At the start of the war in September 1939 the naval mining unit *HMS Vernon* in Portsmouth had advanced far in developing a British model. In fact, in March 1938 Winston Churchill, then First Lord of the Admiralty, proposed in a letter to Defence Minister Thomas Inskip that in the event of war against Germany, the British should place magnetic mines in the Kiel Canal. But the Germans beat them to the punch. By the end of the 1920s, a small development group had constructed a reliable magnetic ignition, and from 1935 development had reached the point where the mine went into mass production. By the outbreak of war, the Germans had around 1,500 magnetic mines ready.

3,000
British ships were demagnetised in a process called "wrapping", which used live cables to counter German magnetic mines.

OFFICERS WERE WOKEN

One of the mines gave the British an unexpected breakthrough. In the evening of 22nd November, a patrol saw a German plane dropping something in the water at the mouth of the Thames. The Coast Guard believed that it was a man in parachute and waded out to investigate. But the tide forced the men back to land, and instead they reported the incident to London. Luckily Churchill and Admiral of the Fleet Dudley Pound had previously decided to keep two of *HMS Vernon's* experts on standby.



Regular mines that floated on the sea's surface did not cause as much damage as magnetic mines.

Lieutenant Commander John GD Ouvry and RC Lewis were woken at the London hotel where they were staying and ordered to recover the item at all costs. At 01.30 the officers were on their way. The night was dark and it was raining, but with the help of a signal lamp, it was possible to locate the object – a cylindrical aluminium container, about two metres long and about 60 centimetres in diameter. At the tip it had a tubular horn that stretched to all sides, and the back housed room for a parachute. Eventually, Ouvry and Lewis identified the cylinder as a magnetic mine – the British had managed to capture an intact copy of the German's secret weapon.

DISARMING WAS DANGEROUS

At noon the next day, demagnetising tools from the mining section in Portsmouth arrived in addition to tools that were custom-made for the task. During the night Ouvry and his assistant emptied their pockets of any metal objects and waded to the mine. And while the rest of the salvage team remained at a respectful distance, the two men began to disarm the mine. As the work progressed, Ouvry reported to Lewis, who stayed a distance away. Ouvry's observations could be useful if the bomb went off and he died during the disarming. Fortunately, it did not happen. After some nervous minutes, Ouvry carefully detached the detonator, rendering the 500-kilogram mine harmless.

The mine was loaded on a truck and driven to Portsmouth for further investigation where – on Churchill's orders – staff worked day and night to reveal its secrets. The British investigations revealed a so-called magnetic sensor, which did not require actual physical contact to detonate.

The special thing about the German model in relation to what the British had worked on was that it was developed using a new and far more reliable principle. The British version was based on a magnetic coil – a system that tended to fail. When a ship passed the German mine, it emanated a magnetic signature causing a magnetically charged needle on the mine to drop, connect an electrical circuit and trigger the explosive charge.

Pressure waves hit below the waterline

At the same time, the magnetic mine was surprisingly simple. Until now, magnetic mines could only be installed by ship because the iron shell made them too heavy to be transported by air. But the German mine had a lightweight aluminium shell and could be dropped from almost everywhere.

British technicians also discovered that when the mine was laid, a number of devices ensured that it was working and that the water depth was correct. When all systems reported clear, the mine armed itself and was ready for blasting. If not – for example, if the mine was in low water – it was set to blow up immediately so as to not fall into the enemy's hands. Luckily for the British, this security measure had failed in the mine that was fished out of the Thames.

The magnetic mines were far more dangerous than ordinary mines floating on – or just below – the water's surface. Traditional mines typically caused damage to the front of the ship and around the waterline, which in many cases could be repaired. But devastating pressure waves from the magnet mines hit the waterline on load-bearing structures causing damage that was almost impossible to repair at sea.

Magnetic field was neutralised

At *HMS Vernon*, a research team led by CF Goodeve was challenged to find a way to defuse the German magnetic mines. And at the end of December, Goodeve was able to give Churchill a Christmas present: the research team had invented a technique called "degaussing", named after physicist and magnetic-field pioneer Carl Friedrich Gauss.

The method involved installing electromagnetic coils in the ship, which neutralised the ship's magnetic field. This was expensive, so a cheaper option was devised known as "wiping", whereby a large electric cable exposed ships to strong magnetic fields that demagnetised them, but this was only a temporary fix, and wiping had to be repeated regularly.

The research team also developed techniques for locating the mines: these minesweepers were largely constructed from wood and fitted with high-power cables that they dragged behind them. The cables created powerful magnetic fields that caused the underwater magnetic mines to explode.

The hunt extended to the air. Bombers were equipped with a metal ring that served as a giant electromagnet. The ring generated such a large magnetic field that many magnetic mines detonated when the plane passed at low altitude.

Germany was undaunted and continued to deploy magnetic mines. From the beginning of 1942, German submarines laid about 330 magnetic mines off the east coast of the US, sinking 11 ships. But, thanks to British countermeasures, the threat had been largely eliminated in Europe.

Thousands of mines were removed

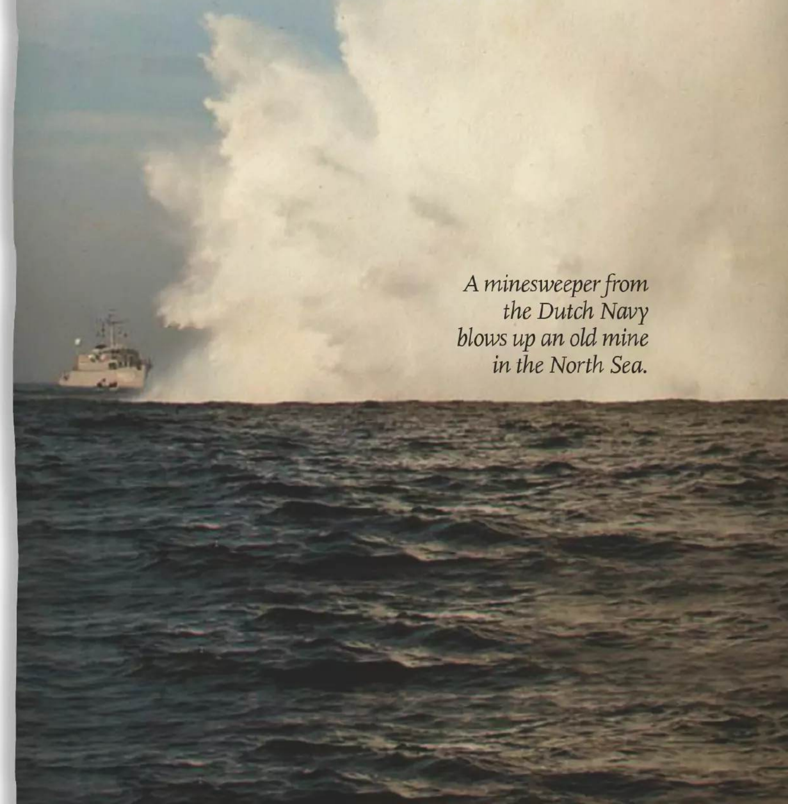
Sea mines were effective, but after the war a colossal job of removing the deadly mines followed – a job that is still ongoing.

A large number of the hundreds of thousands of sea mines laid during the war were never accounted for. Mine clearance after the war was therefore a giant task, which was carried out primarily by Britain's Royal Navy, which had the greatest expertise in mine clearance.

However, despite the efforts, the seas still hide mines. During the construction of Nord Stream, a natural gas pipeline from Russia to Germany that was completed in 2012, miners found around 80 unexploded mines in a 50-metre-wide corridor being cleared on the Baltic seabed.

Efforts are also taking place in the North Sea. After a tragic episode in 2005, when three Dutch fishermen died when their cutters hit a mine, Operation Beneficial Cooperation was launched. The project is an international collaboration, and so far more than 1,000 mines have been detonated.

700,000	mines were released during the war.
650	Allied ships were lost as a result of mines.
1,100	Axis ships sank.
1,100	old mines have been detonated in the North Sea since 2005 through an international project.



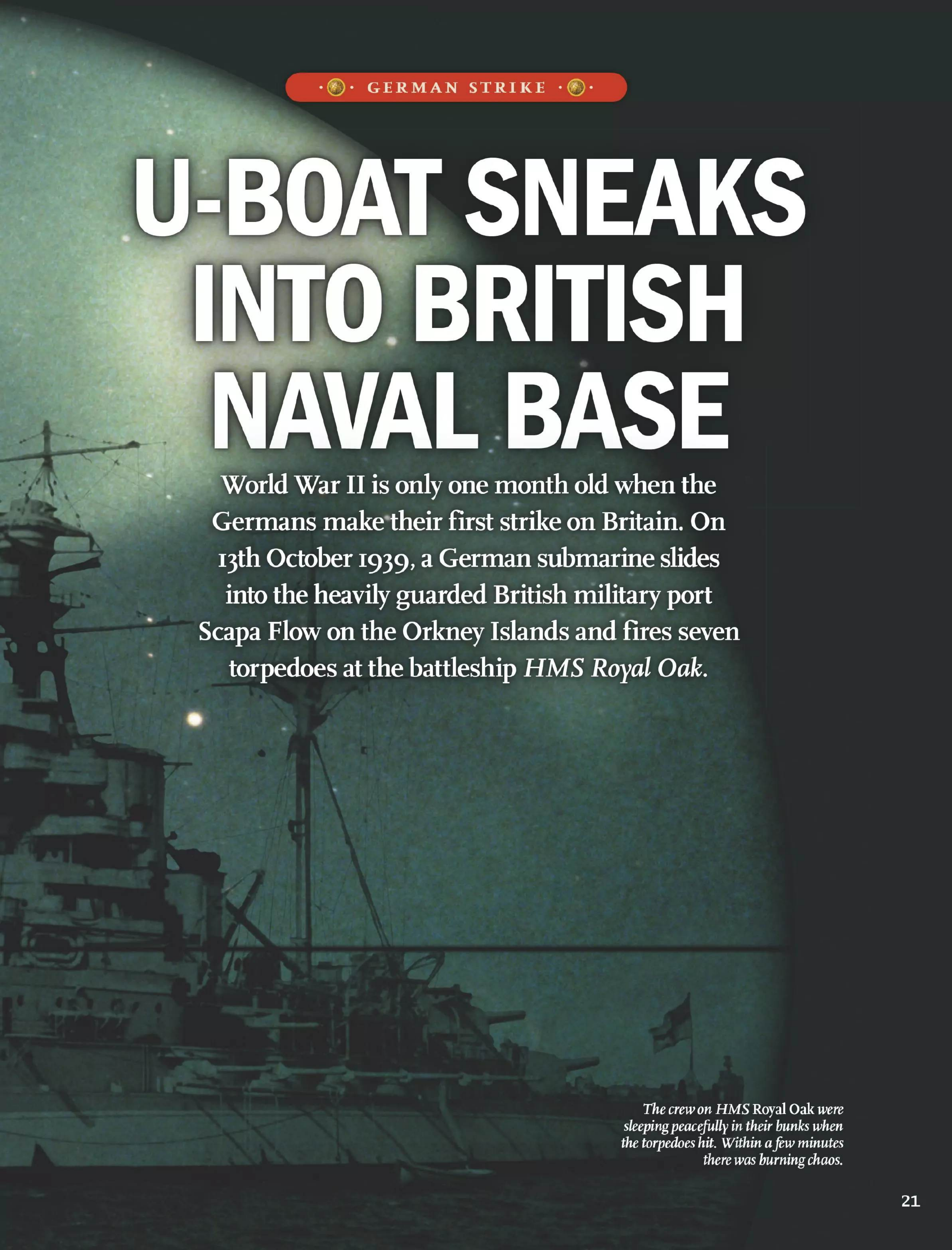
A minesweeper from the Dutch Navy blows up an old mine in the North Sea.

1939

13TH OCTOBER

U-BOAT SNEAKS INTO BRITISH NAVAL BASE

World War II is only one month old when the Germans make their first strike on Britain. On 13th October 1939, a German submarine slides into the heavily guarded British military port Scapa Flow on the Orkney Islands and fires seven torpedoes at the battleship *HMS Royal Oak*.



The crew on HMS Royal Oak *were sleeping peacefully in their bunks when the torpedoes hit. Within a few minutes there was burning chaos.*

Scapa Flow
BRITAIN
Kiel
GERMANY

War breaks out in September 1939, but at the old base of Scapa Flow on the Orkney Islands the British feel safe. The base is almost impregnable, protected by sunken ships, submarine nets and an unpredictable tide. But the enemy has found a hole in the defences and outside the base, a German submarine lurks on the sea floor.

30 merchant ships from eight different countries were sunk by the German submarine *U-47*. Among them were four Norwegians, one Swedish and one Danish.

THERE WAS A CHILL IN THE AIR on the evening of 13th October 1939. Everything was quiet aboard the battleship HMS *Royal Oak*, which was anchored at Scapa Flow in the Orkney Islands, one of Britain's safest and most closely guarded ports.

Sunken naval vessels blocked the entrances to the harbour and between these blockships were submarine nets, meaning that the crew of the almost 200-metre-long *Royal Oak* could sleep soundly – despite the fact that Britain had just declared war on Germany following Hitler's invasion of Poland the previous month.

Suddenly, a series of massive explosions filled the air with a deafening roar. Flames shot outwards from the *Royal Oak* and a huge column of water spurted up from beside the battleship's hull. Pieces of mast, chimneys and the command bridge were flung into the air along with a number of unfortunate crew members. Several were blasted skywards, already dead before they landed in the oil-coated sea. The cries of burning sailors competed with shouts for help from those who were already drowning in the oil-slicked waves.

The old British warship had been hit hard and now she was sinking fast. Precious minutes were lost before the British discovered what had happened.

Against all odds, an enemy U-boat had stolen into the naval harbour, fired a deadly salvo of torpedoes and was already on her way back through the shallow Kirk Sound, despite the four blockships that supposedly obstructed the exit.

The fleet commanders had been so sure that no vessel could penetrate the Kirk Sound with its shallow waters and erratic tides that they had neither mined it nor stretched any submarine nets between the blockships.

HMS Royal Oak had earned her place in the British fleet in 1914, but gradually she became too slow for modern war.

MINEFIELDS PROTECTED FLEET

Anti-submarine nets were part of the standard defences used in many Royal Navy bases where warships docked for repair or supplies. One of the oldest and best-guarded was Scapa Flow. It had been in use since the Viking age and formed a natural harbour with a bay protected by several surrounding inlets and islets.

The harbour was located in the heart of the Orkney Islands just off the north coast of Scotland, and had been reinforced during World War I with mines, submarine nets and blockships. Among the sunken ships were several German vessels from WWI, which had been detained in Scapa Flow and later sunk.

The sinking of proud Kriegsmarine warships was not the only humiliation that the Germans experienced in connection with Scapa Flow. Twice during WWI, Germany had attempted to attack British ships in the guarded natural harbour, but both missions had failed.

The first attack came in November 1914, when the submarine *U-18* was hit and sunk by a trawler. The second was in October 1918, when *UB-116* was discovered using hydrophones and destroyed with a remote controlled mine. The German desire to hit the British fleet in Scapa Flow was not therefore motivated purely by strategy: a successful attack also have great symbolic value for the Nazi regime.

ADMIRAL FOUND A HOLE IN THE DEFENCE

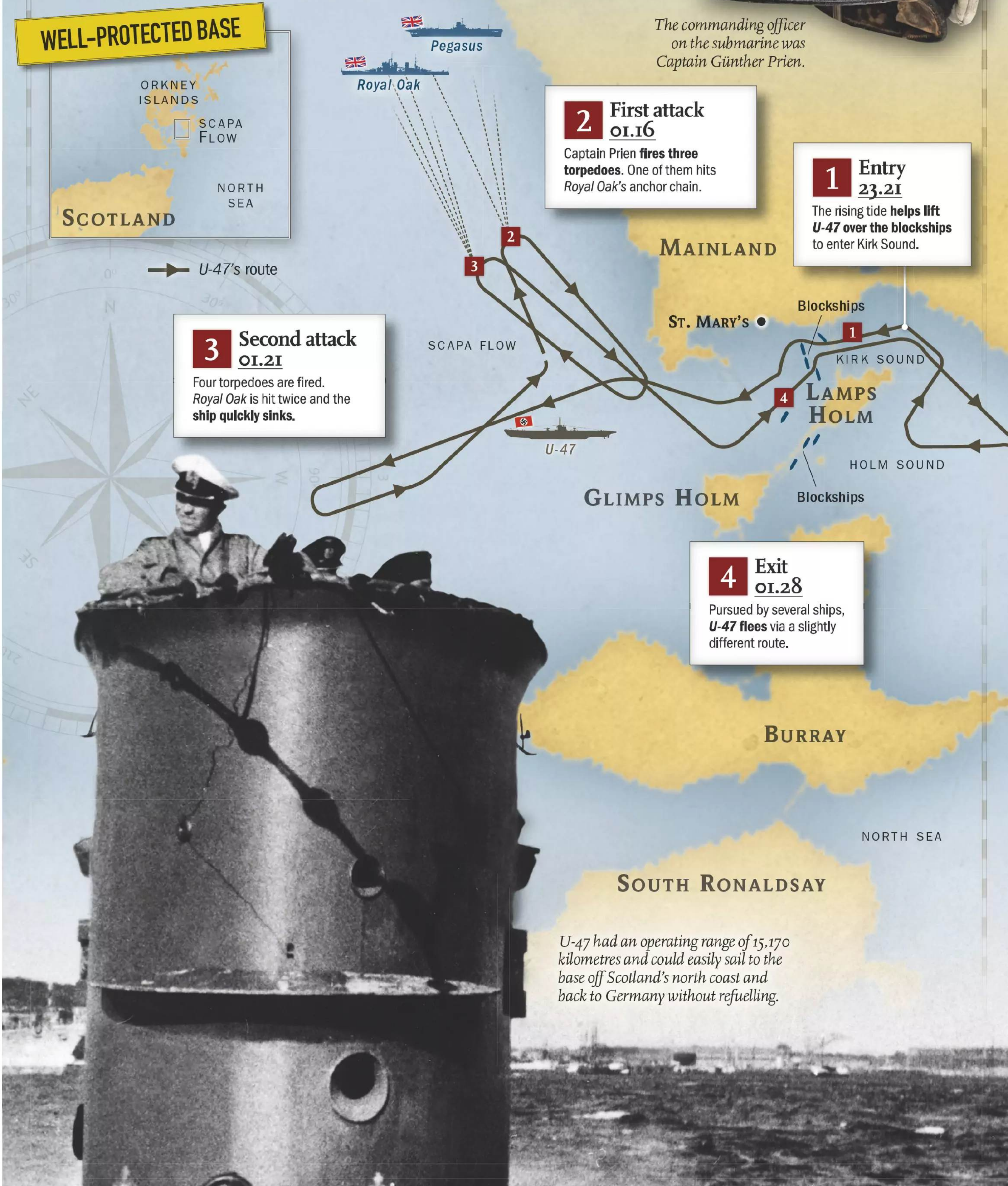
The plan for the attack on Scapa Flow had originated at the top of Kriegsmarine command when Rear Admiral Karl Dönitz, who commanded Germany's submarine operations, discovered a gap in the base's defences.

Dönitz realised that the British had failed to deploy any submarine nets in the eastern stretch of Kirk Sound, and that only four major blockships protected the deepest water in the strait. A narrow, low-tide passage in the

U-47 gets into Scapa Flow

Access to Scapa Flow was blocked by scuttled ships, but the strong tides in Kirk Sound helped *U-47* enter the harbour, where two British battleships – HMS *Royal Oak* and HMS *Pegasus* – lay at anchor.

The commanding officer on the submarine was Captain Günther Prien.


WELL-PROTECTED BASE
ORKNEY ISLANDS
SCAPA FLOW
NORTH SEA
SCOTLAND
U-47's route
Pegasus
Royal Oak
MAINLAND
ST. MARY'S
Blockships
KIRK SOUND
LAMPS HOLM
HOLM SOUND
Blockships
SCAPA FLOW
U-47
GLIMPS HOLM
BURRAY
NORTH SEA
SOUTH RONALDSAY
1
2
3
4

1 Entry
23.21

The rising tide **helps lift *U-47* over the blockships** to enter Kirk Sound.

2 First attack
01.16

Captain Prien **fires three torpedoes**. One of them hits *Royal Oak*'s anchor chain.

3 Second attack
01.21

Four torpedoes are fired. *Royal Oak* is hit twice and the **ship quickly sinks.**

4 Exit
01.28

Pursued by several ships, ***U-47* flees** via a slightly different route.

U-47 had an operating range of 15,170 kilometres and could easily sail to the base off Scotland's north coast and back to Germany without refuelling.

1908-1941

NAME **GÜNTHER PRIEN**

TITLE U-BOAT CAPTAIN

Jobless to people's hero

Günther Prien's childhood was characterised by poverty. He was raised in Leipzig by his mother, who made her living by making lace. At 15 years of age, Prien joined the German merchant navy and became a deckhand on a freight ship. Everyday life was hard, with frequent fighting and lousy wages, but the young man endured his term and gradually battled his way through the hierarchy to graduate as a naval officer.

But no one would hire him. The bitterness of broken dreams led Prien to join the Nazi party. In 1933, when Germany started to rebuild its fleet, Prien grabbed the chance to work in the Kriegsmarine. After starting as a sailor, he once again rose quickly through the ranks, ending up as a submarine captain.

The mission to Scapa Flow made Prien a national figure, and he quickly became known as one of Germany's submarine heroes. But his fame was brief. On her 10th patrol in 1941, his submarine *U-47* was destroyed by depth charges dropped by the British destroyer HMS *Wolverine* and the entire crew perished.

- **Graduated from naval school in 1932.**
- **Received his first submarine command in 1938.**

northernmost part of the entrance also remained open. To the south, a 170-metre-wide, eight-metre-deep channel offered a navigable channel that a German submarine could use to squeeze into Scapa Flow. Even better, the coastline there was virtually uninhabited.

Dönitz believed that Scapa Flow could be penetrated through Kirk Sound at high tide when the water in the channel would be at its deepest.

All he needed was a suitable man for the operation. The admiral turned his gaze on Captain Günther Prien. In the month since the war broke out, Prien had sunk three British merchant ships. Dönitz recognised him as an ambitious, gifted and bold captain.

The rear admiral offered Prien the mission, but the captain didn't respond immediately. Instead, he spent the night studying all the material he had been given in relation to the task. This included charts and intelligence reports along with photographs and information from air reconnaissance. He also analysed previous assault attempts and considered the possibilities afforded by the weakness Dönitz had discovered, and made a preliminary attack plan. The following morning, the captain accepted the mission.

833 men out of 1,223 on board *HMS Royal Oak* were killed when the Germans sank the battleship. The attack led to greatly improved security in British sea ports.

Tide pulled U-boat into the bay

Prien chose to follow Dönitz's idea of allowing his U-boat, *U-47*, to be pulled into Scapa Flow by the high tide in the shallow Kirk Sound. He planned the mission for 13th October when his vessel would be hidden from the new moon's minimal light. On 8th October, ammunition and other supplies were loaded, and Prien and his crew secretly departed from Kiel. After four days at sea, the submarine reached the Orkney Islands on 12th October. At 04.00 the next morning, the captain took the U-boat to the seabed beside Scapa Flow.

Only then did he gather the crew and brief them on the mission. They were ordered to lie down and rest in order to save precious oxygen while *U-47* was submerged. The men wrapped their boots in rags, because the British monitors in Scapa Flow were so efficient that even a small kick against the hull's steel plates would be heard on the surface.

Northern Lights posed potential problem

In the evening the men had their last meal. After demolishing the pork chops and green cabbage, the crew quietly cleaned up and made ready for battle. Finally, at 19.00 Prien gave orders to head to the pumps. The submarine rose through the water before her periscope was deployed to scan the horizon.

The night was dark and the sea empty. Assured that no enemies were nearby, Prien brought *U-47* to the surface and started her diesel engines. The submarine slowly began to slide towards the coast, but suddenly a clear light spread across the horizon. An amazing Northern Lights display had lit up the sky over the North Sea, but *U-47's* crew didn't appreciate its beauty – darkness was crucial for their impending attack. Prien briefly considered postponing the mission for a day, but his men were ready so he took a chance rather than waiting out another 24 hours on the seabed. Bathed in the glow of nature's own light show, the German submarine slowly slipped into Holm Sound – the easternmost entrance to Scapa Flow. Each time the silhouette of a ship appeared in the distance, *U-47* dived beneath the surface.

The many dives up and down tested the patience of both captain and crew. At the same time, the turning tide in the Orkney Islands made conditions erratic and unpredictable.

Close to Kirk Sound, things nearly went horribly wrong. Prien had just 15 meters to spare when he passed the blockship *Soriano*, but the tide suddenly forced the submarine against the sunken ship – just as the captain spotted an anchor chain in front of them. The order for full astern was given, but too late. With a screaming sound, the hull hit the seabed and the submarine became stuck.

Prien ordered the helm hard to port, and in one movement the U-boat freed herself, slammed around the anchor chain and continued to move forward. *U-47* was in Scapa Flow. Through the periscope, the captain searched the horizon, but there was not a single enemy ship in sight.

BRITISH SHIPS HAD BEEN LURED AWAY

The lack of British targets could be explained by an error in the Germans' intelligence. A week earlier, most of the fleet's strength in Scapa Flow had been at sea, where the ships had been attacked by Luftwaffe. The attack had failed, but fear of a repeat attempt made the Royal Navy relocate to Loch Ewe in Western Scotland instead of heading back to Scapa Flow.

This information had not been passed on to Prien. Still unaware of the reason for the fleet's disappearance, the captain decided to search the bay more thoroughly and sailed further westward. Half an hour after midnight he caught sight of a ship belonging to the Coast Guard, but the small vessel did not meet his criteria of an important military target worth attacking.

Prien turned the submarine around to head back east before ordering a course north along the coast of

U-BOAT DIVED TO AVOID BRITISH DEPTH-CHARGES

8th October

11.00: Departs from Kiel through the Kiel Canal.

9th October

Passes the day immersed south of Dogger Bank.

10th October

Spends daylight hours submerged north of Dogger Bank.

13th October

04.37: Remains static while the crew rests. Position is 90 metres deep, east of Scapa Flow.

23.31: Rises to the surface and in Holm Sound. Briefly runs aground in Kirk Sound. Continues into Scapa Flow.

14th October

0.55: Turns up the coast and spots the battleships HMS *Royal Oak* and HMS *Pegasus* at an estimated distance of three kilometres.

01.16: Fires three torpedoes.

01.21: Fires four more torpedoes. Two are full hits.

01.28: Both engines are set to full power. *U47* exits Kirk Sound via the southern channel, because the countercurrent and shallow water makes the northern route impassable.

02.15: Sails into open waters on south-eastern course back towards base. British ships follow.

06.30: Lies still as British drop depth charges.

15th October

06.00: Stays submerged at 72 metres depth until dusk. Records at least 32 depth-charge explosions.

17th October

11.00: *sailors parade as they arrive in the fleet port Wilhelmshaven.*

After the trip, U-47 *returned to Wilhelmshaven, where the crew was greeted with kisses and flowers.*

Adolf Hitler personally awarded Iron Cross medals to U-47's *crew members.*

the mainland. Here he finally found suitable prey. In *U-47's* periscope two battleships appeared, and he dropped anchor around three kilometres away. Further inside the harbour were several destroyers, but Prien quickly decided to go for the big ships.

At 01.15, the crew of *U-47* loaded four torpedoes into the sub's tubes. Two were aimed at the southernmost ship on the horizon, HMS *Royal Oak*, while the other two were intended for HMS *Pegasus* further north. With a slight tremor, three torpedoes were successfully fired, but the last one became stuck in the tube.

After firing, Prien and his men waited anxiously, counting down the seconds as the torpedoes sped towards their destination. Three-and-a-half minutes later the first torpedo struck *Royal Oak's* anchor chain and exploded, while the other two disappeared into the water's darkness.

Torpedoes sank the British ship

Confusion reigned aboard *Royal Oak*. Nobody dreamed that the battleship had been hit by a German sub. The crew believed it was only a minor explosion – perhaps one of the ship's own bombs that had gone off by accident.

Prien was undeterred despite the failed attack and ordered another attempt. Five minutes later, all four torpedo tubes were ready for action. This time, two of the torpedoes hit *Royal Oak* in the middle of her hull. With a deafening sound they opened a hole nine metres wide in the ship's side. The battleship's ammunition store was probably hit because the explosion was so powerful that parts of the torn hull were hurled into the water.

The *Royal Oak* was doomed. Water gushed into the hull and the ship began listing to one side. Just 13 minutes after the torpedo had hit, the old warship disappeared into Scapa Flow's dark waters.

Prien ordered his crew to set course to exit the bay. Both engines were powered up, but before the sub could make good its escape, problems arose.

U-boat fled with British at its heels

Prien had spent so long searching for ships in Scapa Flow, the tide had turned and the water depth in Kirk Sound was critically low – in some places it was less than three metres. The strong countercurrent knocked the 66-metre-long sub off course again and again, and Prien realised that *U-47* could not get out of the narrow northern passage.

He headed for the wider southerly channel out of Kirk Sound, but the water depth here was even lower than in the north. The sub's speed was lowered to 18 km/h while it edged past the southernmost blockship close to shore.

Only a few centimetres separated *U-47* from bumping land on one side and colliding with the blockship on the other. The helm was pulled over hard and the U-boat narrowly escaped striking hard concrete.

By 02.15, *U-47* had reached open sea. It was being followed by British destroyers with exploding depth charges, which forced the U-boat to remain on the surface.

Führer rewarded crew personally

Four days later, on 17th October at 11.00, *U-47* arrived at the naval base of Wilhelmshaven. The crew was met by Grand Admirals Erich Raeder and Karl Dönitz before travelling on to Berlin, where the Führer awaited.

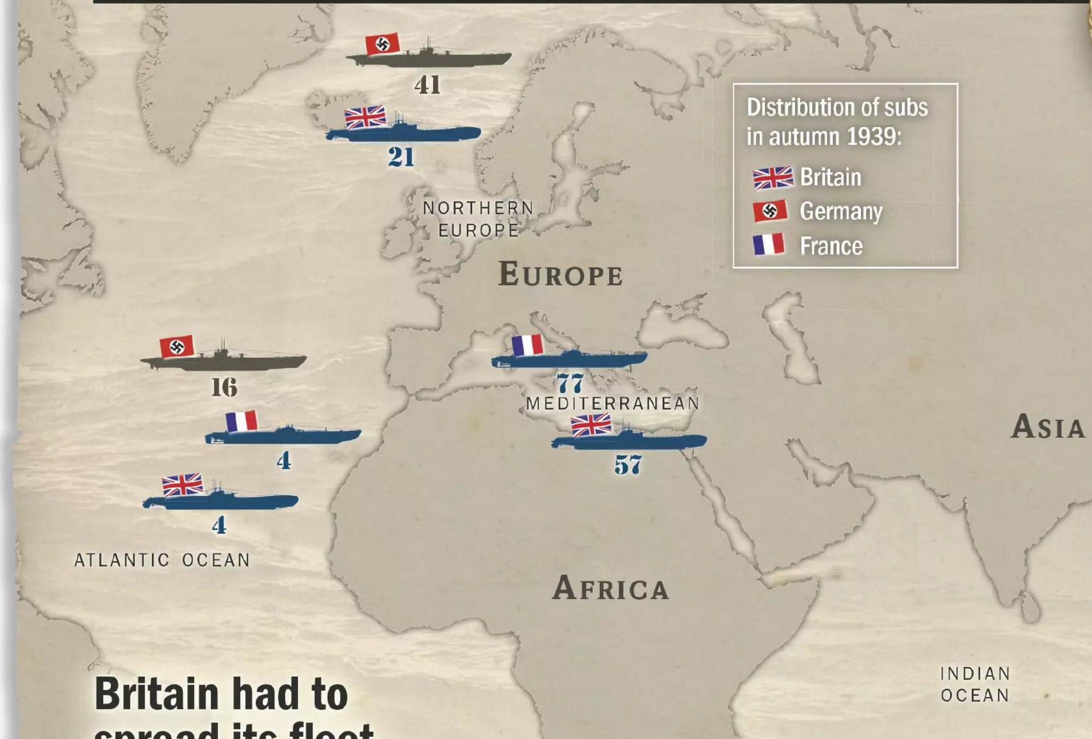
After an open-top parade through Berlin's streets, Hitler received Captain Prien and his crew for a gala dinner, where all were awarded the Iron Cross. It was Prien's proudest moment, but he quickly returned to Kiel and active service.

The captain had become famous and was widely acclaimed as one of the Kriegsmarine's submarine heroes. He would go on to sink 30 Allied ships before being killed on 7th March 1941. A depth charge from British destroyer HMS *Wolverine* destroyed the U-boat's propeller making it so noisy that the destroyer could track *U-47's* position. All 45 crew members died in the action that finally sank Günther Prien's vessel.

The Nazis had the lead underwater

The Treaty of Versailles, signed after World War I, forbade Germany from possessing submarines. But after taking power in 1933, the Nazis immediately started building a large U-boat fleet. It was key to their dominance in Europe.

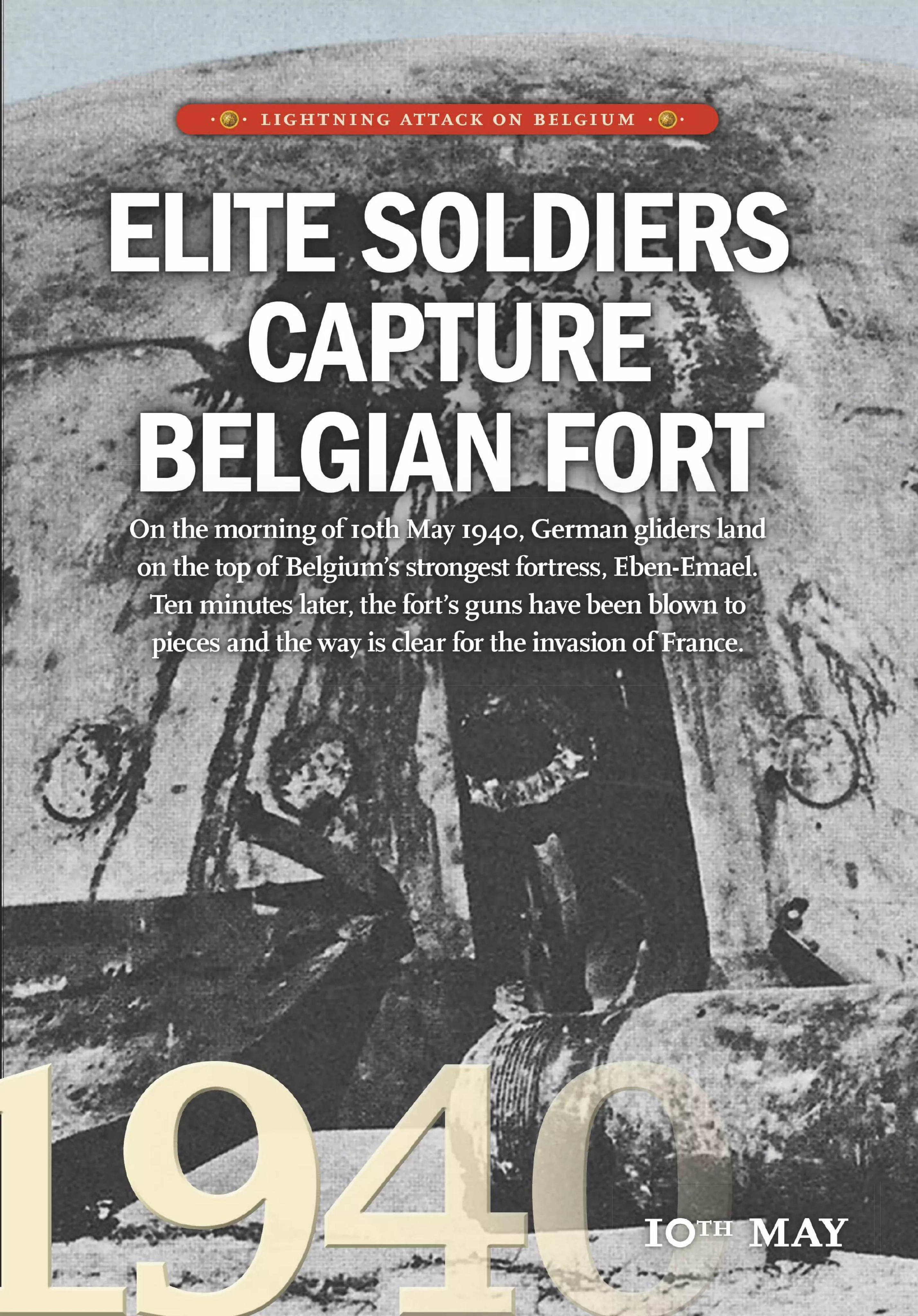
The U-boat War Badge was given to sailors after two successful missions. It combined an eagle, swastika, submarine and wreath.


Distribution of subs in autumn 1939:
🇬🇧 Britain
Germany
🇫🇷 France
41
21
NORTHERN EUROPE
EUROPE
16
4
4
ATLANTIC OCEAN
77
MEDITERRANEAN
57
AFRICA
ASIA
1
THE FAR EAST
15
INDIAN OCEAN

Britain had to spread its fleet

According to a 1935 naval agreement, Germany had no more submarines than Britain, but while the British had to distribute their fleet across the world to protect their empire, the Germans could concentrate their U-boats in Europe.

The naval base at Wilhelmshaven in the North Sea was one of the most important to Germany's Kriegsmarine.

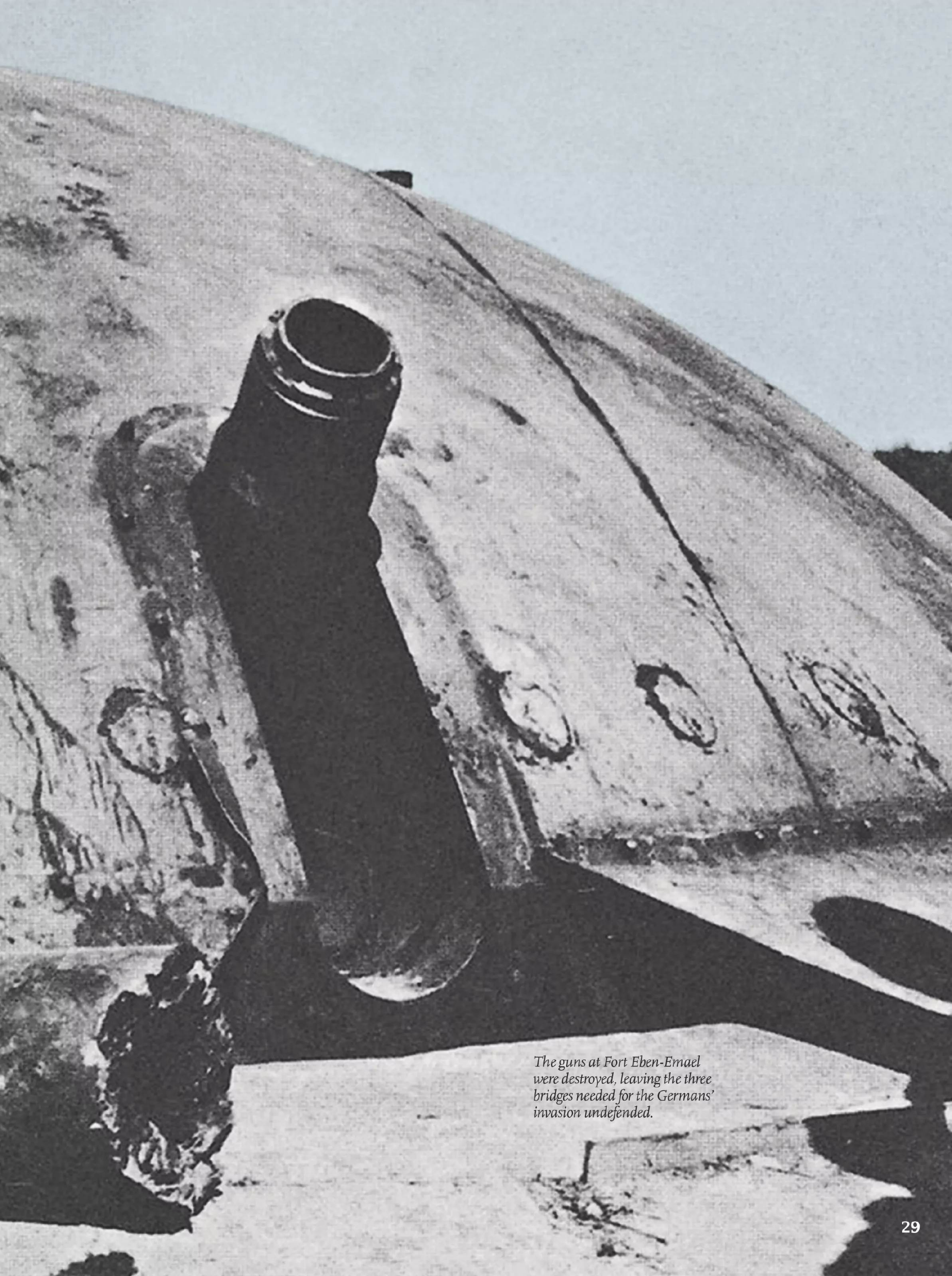


ELITE SOLDIERS CAPTURE BELGIAN FORT

On the morning of 10th May 1940, German gliders land on the top of Belgium's strongest fortress, Eben-Emael. Ten minutes later, the fort's guns have been blown to pieces and the way is clear for the invasion of France.

1940

10TH MAY



The guns at Fort Eben-Emael were destroyed, leaving the three bridges needed for the Germans' invasion undefended.

Belgium 1940

THE STAGE IS SET

The German war machine is rolling towards France, but a major obstacle stands in its way. The Belgian fort of Eben-Emael guards the bridges over the River Meuse and Albert Canal, which the Germans must cross to capture Western Europe. The fort must therefore be taken – even if the task seems impossible.

The glider's canvas creaked and fluttered. Eight men sat huddled together on the narrow bench in the middle of the fuselage. They shared the small space with ammunition belts, machine guns and flame-throwers. Clamped along the side were the new explosives that German scientists had spent over a year developing. Soon they would be put to the test.

Through the morning mist the pilot could make out the outline of the Belgian bunker system. He gave a signal, and the men in the plane tightened their grip for landing. The glider bumped over the grass, its cabin shaking uncontrollably before the parachute brake took effect. With a judder, the plane stopped and stood completely silent on the shorn grass. All around the glider were huge gun turrets. Below, in the underground bunker, around a thousand Belgian soldiers slept on.

Sergeant Hans Niedermeier immediately grabbed an explosive, jumped out and stormed the gun's position as he'd been taught during training in Czechoslovakia. It was 05.50 on Friday, 10th May 1940. The attack on Eben-Emael was under way.

Hitler planned a special operation

Seven months earlier in October 1939, Major General Kurt Student, head of Germany's airborne and air-landing troops, marched into a small walnut-panelled room in Berlin. At the end of the room, the Führer stood behind a large desk studying a detailed map.

The meeting between Hitler and the general was short. The Führer pointed to the Belgian fort of Eben-Emael on the map and asked whether it was possible to land gliders on its top when the invasion of France, Belgium and the Netherlands began. Student asked for a day to find out and report back.

No soldier had ever attacked with gliders – and never such a highly fortified and largely impenetrable fortress. On the other hand, Student was convinced of his paratroopers' abilities. The next day, he returned to confirm that his soldiers could carry out the task – but only in daylight.

The general's word was enough for Hitler, who had personally formulated the attack plan for the most important fort in Belgium, Eben-Emael. A paratrooper unit needed to neutralise the Belgian concrete fortress before its heavy guns

The German elite soldiers trained for six months to disable the fort's defences with maximum efficiency.

SHAPED CHARGES

New explosive cleared way

During the attack On Eben-Emael German forces used shaped-charged explosives for the first time – to devastating effect.

Shaped-charged explosives were used in 1944 in the German panzerfaust, which could blast through tanks.

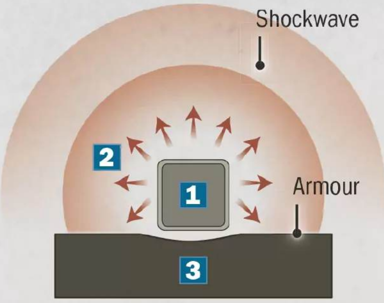
Eben-Emael's thick walls were penetrated by a new specially designed German weapon: shaped-charges.

During World War I, French concrete bunkers had survived everything that was thrown at them – even withstanding non-stop bombardments by German guns.

Hitler therefore demanded an explosive that could take a bunker out of action with a single blast.

He ordered German scientists to work in secret on developing a more efficient form of explosive. The new shaped charges they created focused the blast in one direction.

The result was a destructive shockwave that could penetrate both armour and concrete. The principle behind these shaped charges is still used today in all artillery guns.

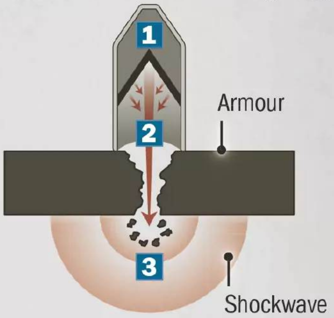


Common explosive charge

1 The explosive charge is encased in a metal shell.

2 The explosion is equally powerful in every direction.

3 Armour and concrete absorb the blast directed towards them.



Shaped explosive charge

1 The explosive is located at the end of the charge.

2 The cavity is filled with air.

3 When triggered, all the explosive's force is channelled through the cavity in a single direction - maximising the blast.

slowed the German advance into Belgium. The gliders were part of a bigger plan, however, one that involved additional paratroopers securing three key bridges over the River Meuse and Albert Canal, which marked the Belgian border.

Soldiers trained for six months

In November 1939, training began for 85 selected paragliders. The unit was codenamed Group Granite and divided into 11 smaller groups. Over the next six months they underwent intensive training, which was later moved to Czechoslovakia. There, the paratroopers landed again and again on a faithful reproduction of Eben-Emael built into the Beneš Wall, the border fortifications begun by the Czechs prior to their occupation. During the spring, Granite's pilots practised the gliders' approach and landing to perfection.

At the same time, German scientists researched a new type of explosive with shaped charges. The weapons project was so secret that the group was not allowed to train with the new explosives. Instead, it used dummy versions to perfect their attack on the fort's machine-gun posts and heavy artillery.

The training continued until the groups could land and reach their targets within the one-kilometre-square complex in under ten minutes. In early April 1940, Group Granite was called back to Germany.

Fall Gelb (Operation Yellow) – the German invasion of Holland, Belgium and France – was imminent.

Pilots made emergency landings

Early in the morning of 10th May 1940, 11 Stuka bombers left the Ostheim airbase near Cologne, each one towing a DFS 230 glider connected to it by over a hundred metres of steel wire. Group Granite was on board. Things went wrong shortly after its departure. Two of the planes became caught up in the tow ropes. The two pilots cut the wires immediately, and the gliders began a fast descent. Unfortunately, the raid's leader, Lieutenant Rudolf Witzig, was in one of them.

After an emergency landing near Cologne, Witzig leaped out of the glider and sprinted in the dawn light over the fields before stealing a bicycle and later requisitioning a car. Crushed by the prospect of his men being defeated, the lieutenant continued at furious speed towards the Ostheim airfield where he collected a parachute while a ground crew prepared a new Stuka and DFS 230.

Four hours late, a relieved Witzig was with the group again. But by the time his glider landed at Eben-Emael at 08.00, the initial raid was long finished.

Gliders floated silently across Belgium

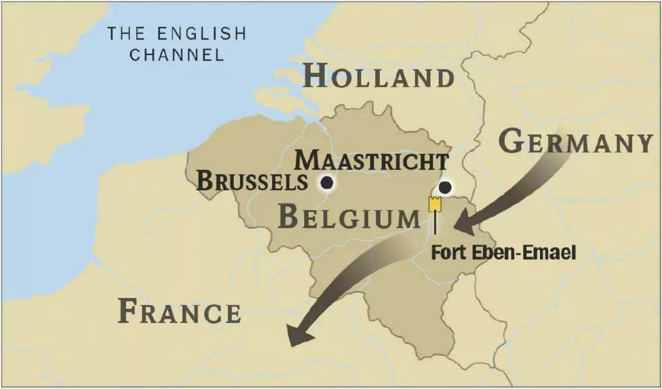
As the orders stated, the pilots in the other aircraft were still travelling westward – led from the ground by lit flares.

After flying for exactly 73 kilometres, the pilots on the Stukas released the gliders, 27 kilometres from Eben-Emael at an altitude of 2.6 kilometres. The

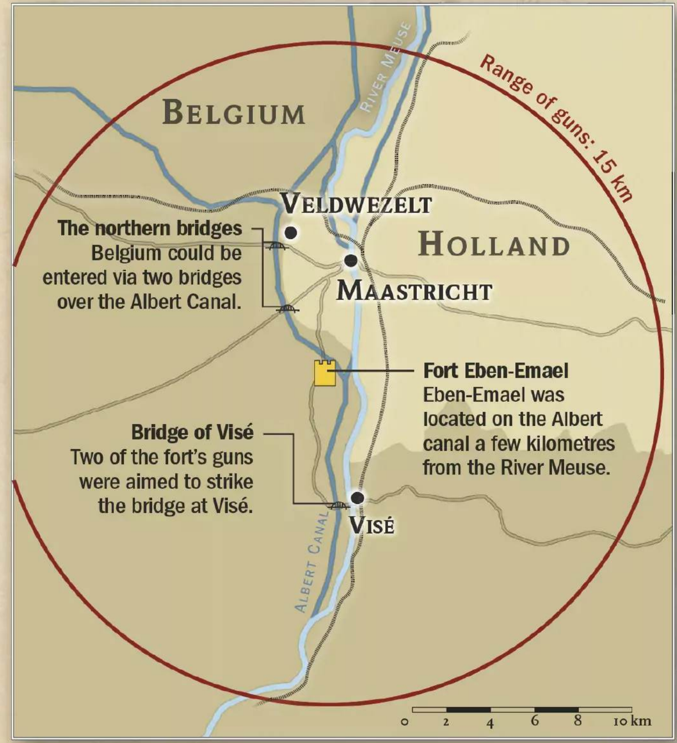
Hitler personally awarded the Knights' Cross to all officers involved in the Eben-Emael mission.

Attack groups soon took the fort

A total of 83 paratroopers in gliders took part. The soldiers were divided into 11 groups, but only nine reached the fort for the raid. Group 2 had an emergency and returned to Germany while Group 11 was delayed en route.


THE ENGLISH CHANNEL
HOLLAND
GERMANY
MAASTRICHT
BRUSSELS
BELGIUM
Fort Eben-Emael
FRANCE

The Germans wanted to invade France via Belgium
Free access through Belgium was a prerequisite for the German invasion of France. So, Eben-Emael had to be taken.


BELGIUM
RIVER MEUSE
Range of guns: 15 km
VELDWEZELT
HOLLAND
MAASTRICHT
VISÉ
ALBERT CANAL
0 2 4 6 8 10 km

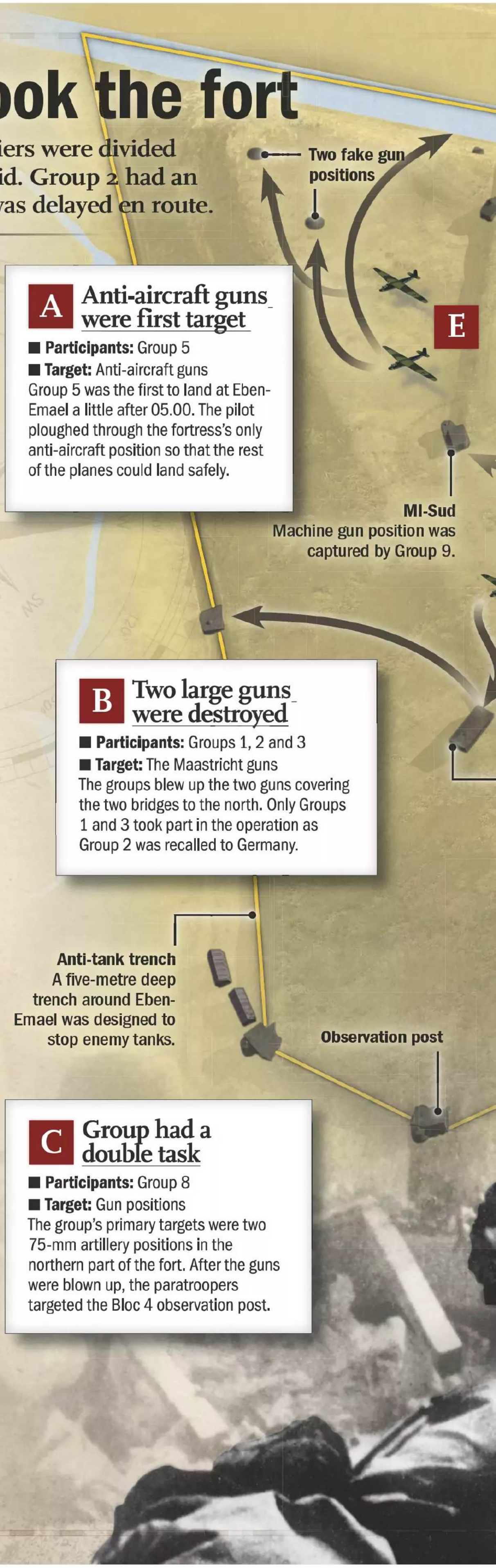
The northern bridges
Belgium could be entered via two bridges over the Albert Canal.

Fort Eben-Emael
Eben-Emael was located on the Albert canal a few kilometres from the River Meuse.

Bridge of Visé
Two of the fort's guns were aimed to strike the bridge at Visé.

Eben-Emael protected three bridges
Military experts considered the Belgian concrete fortress Eben-Emael to be impregnable. The fort was built at the top of a hill and to the east, the Albert Canal made any frontal attack impossible.

A thousand soldiers defended the fortress. At short notice, they could man Eben-Emael's anti-tank and anti-aircraft defences, but their primary duty was operating the fortress's long-range 75-mm and 120-mm howitzers that could blow the bridges over the Meuse and Albert Canal.


Two fake gun positions
E
Observation post

MI-Sud
Machine gun position was captured by Group 9.

Anti-tank trench
A five-metre deep trench around Eben-Emael was designed to stop enemy tanks.

A Anti-aircraft guns were first target

- **Participants:** Group 5
- **Target:** Anti-aircraft guns

Group 5 was the first to land at Eben-Emael a little after 05.00. The pilot ploughed through the fortress's only anti-aircraft position so that the rest of the planes could land safely.

B Two large guns were destroyed

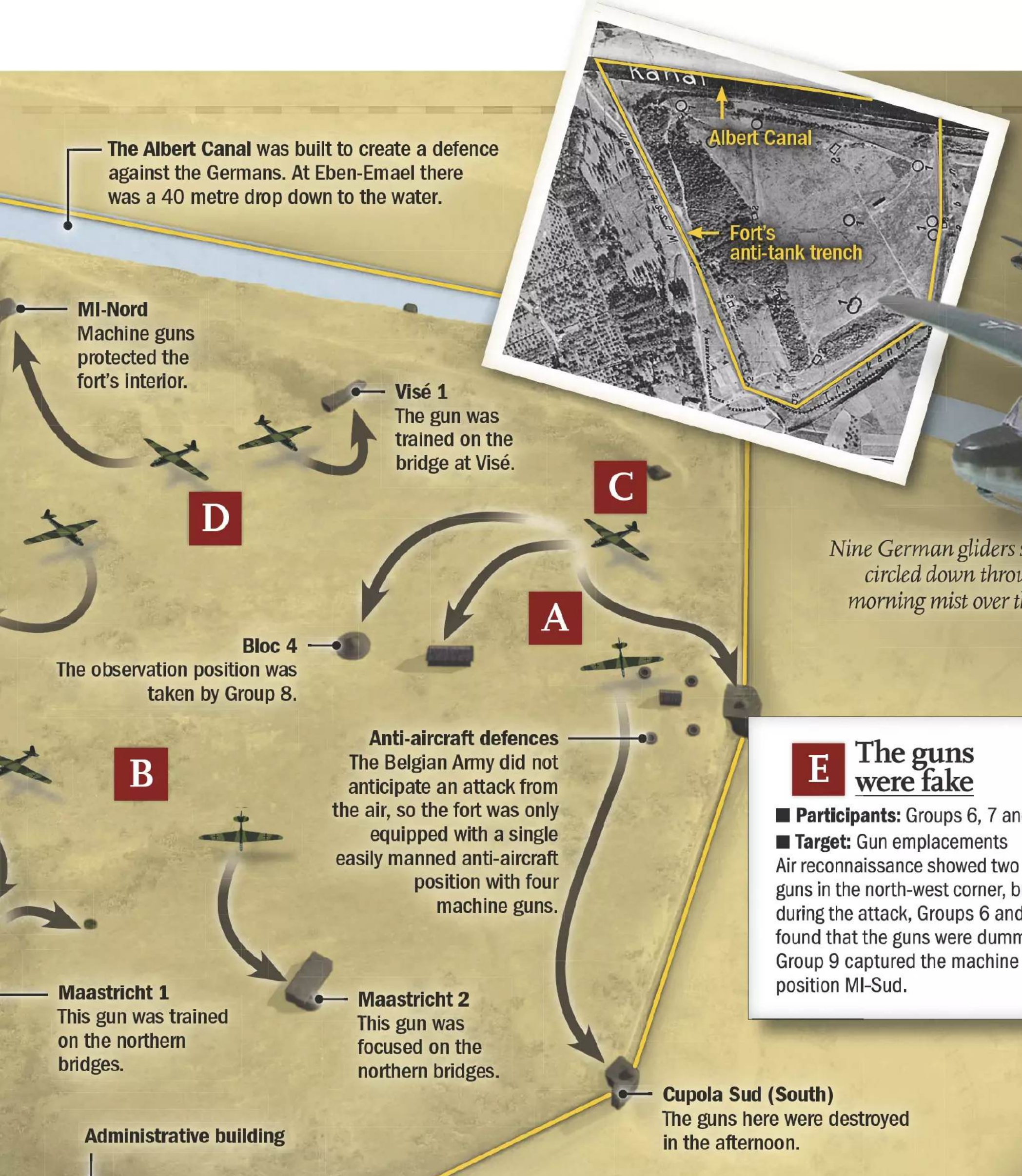
- **Participants:** Groups 1, 2 and 3
- **Target:** The Maastricht guns

The groups blew up the two guns covering the two bridges to the north. Only Groups 1 and 3 took part in the operation as Group 2 was recalled to Germany.

C Group had a double task

- **Participants:** Group 8
- **Target:** Gun positions

The group's primary targets were two 75-mm artillery positions in the northern part of the fort. After the guns were blown up, the paratroopers targeted the Bloc 4 observation post.



The Albert Canal was built to create a defence against the Germans. At Eben-Emael there was a 40 metre drop down to the water.

MI-Nord
Machine guns protected the fort's interior.

Visé 1
The gun was trained on the bridge at Visé.

Bloc 4
The observation position was taken by Group 8.

Anti-aircraft defences
The Belgian Army did not anticipate an attack from the air, so the fort was only equipped with a single easily manned anti-aircraft position with four machine guns.

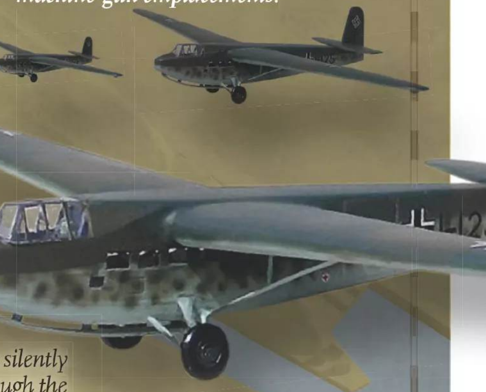
Maastricht 1
This gun was trained on the northern bridges.

Maastricht 2
This gun was focused on the northern bridges.

Cupola Sud (South)
The guns here were destroyed in the afternoon.

Administrative building

German aerial photos revealed the fort's artillery positions and machine-gun emplacements.



Nine German gliders silently circled down through the morning mist over the fort.

E The guns were fake

- **Participants:** Groups 6, 7 and 9
- **Target:** Gun emplacements

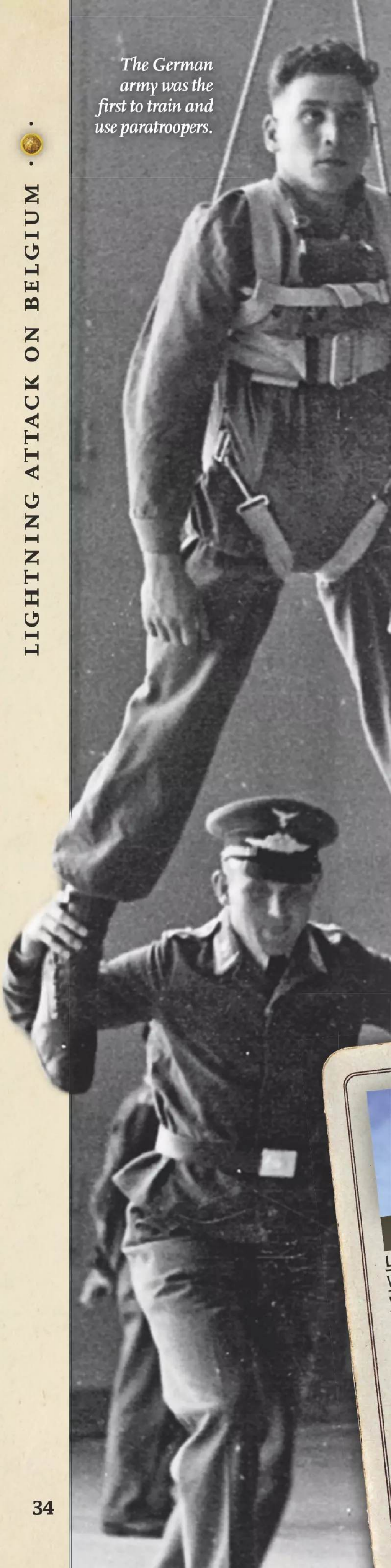
Air reconnaissance showed two guns in the north-west corner, but during the attack, Groups 6 and 7 found that the guns were dummies. Group 9 captured the machine gun position MI-Sud.

D Target cannon and machine guns

- **Participants:** Groups 4, 10 and 11
- **Target:** Visé gun

Group 4 took the MI-Nord machine gun block that protected the fort's interior. At the same time, Group 10 destroyed the Visé 1 gun, which protected the bridge at Visé. Group 11 was delayed and arrived at 08.00.

Armed with explosives and flame-throwers, the Germans captured the Belgian fort.



The German army was the first to train and use paratroopers.

Pilots in Luftwaffe Junker aircraft wore golden pins with an eagle and swastika.

aircraft were left hanging in the air to begin their silent glide across the Belgian border at 124 km/h.

"There was a light ground mist, through which the outlines of the fortification could be dimly perceived," divisional officer Helmut Wenzel recalled of the seconds just before landing.

In the fortress, a guard watching from the anti-aircraft position was astonished to see the gliders circling down to the fortress through the morning mist.

He and his fellow guards fired their machine guns, but only sporadically – in truth, they weren't sure whether the aircraft were British or German. Only when a wing from one of the gliders plunged through the anti-aircraft artillery positions injuring a man did the truth dawn on the Belgians: Eben-Emael was under attack from German forces.

A few seconds later, the four guards found themselves staring down the barrels of two German machine guns. They threw their weapons to the ground and raised their hands.

Eben-Emael was taken in just ten minutes

Over the next ten minutes, Group Granite came to appreciate the effectiveness of its new shaped-charged explosives. Eben-Emael's thick concrete walls and powerful guns were destroyed quickly and efficiently by the targeted explosions.

Sergeant Niedermeier, who triggered a charge, described the effect on an observation bunker: "We could see that the gun had been torn from its mounting [and] lay like a crumpled matchbox in the corner. The opening was 60 cm x 60 cm so it was big enough for anyone to climb in easily".

Beside the blasted gun lay dead and injured Belgian soldiers. The picture was the same throughout the fort. The many months of training had paid dividends. Those involved with Group Granite destroyed their designated targets in a calm, professional manner. And before Eben-Emael's heavy guns could fire a single shot, the German paratroopers had destroyed them along with other fortified positions around the fort.

Soldiers barricaded themselves in

The Belgians who survived the explosions fled inside, into the fort's warren of underground corridors. There they were effectively safe from the German units, but it was a two-edged sword as they were also trapped.

It was a simple matter for the elite German troops to lay siege to the bunker complex. During the next 28 hours, the Germans held Eben-Emael while Belgian defenders waited, cut off, inside the fort.

From the Eben-Emael observation towers, the paratroopers watched column after column of German lorries, tanks and other armoured units roll west over the unguarded border. And on the evening of 11th May, the German army's commanders sent the following telegram to Hitler:

"Eben-Emael, which dominates crossings over the Meuse River and the Albert Canal near and west of Maastricht, surrendered on Saturday afternoon. 1,000 men taken prisoner".

DFS 230

Length	11 m
Width	22 m
Weight	1,300 kg
Engine	None
Crew	10 (including pilot)

ATTACK GLIDER BUILT FROM CANVAS AND STEEL PIPES

The DFS 230 was designed in the 1930s. The wings and hull were made from light steel pipes and tubes clad with canvas. The glider was towed by a plane using a wire 110 metres long. Once the target was in range, the plane released the DFS 230, which glided silently towards the enemy.

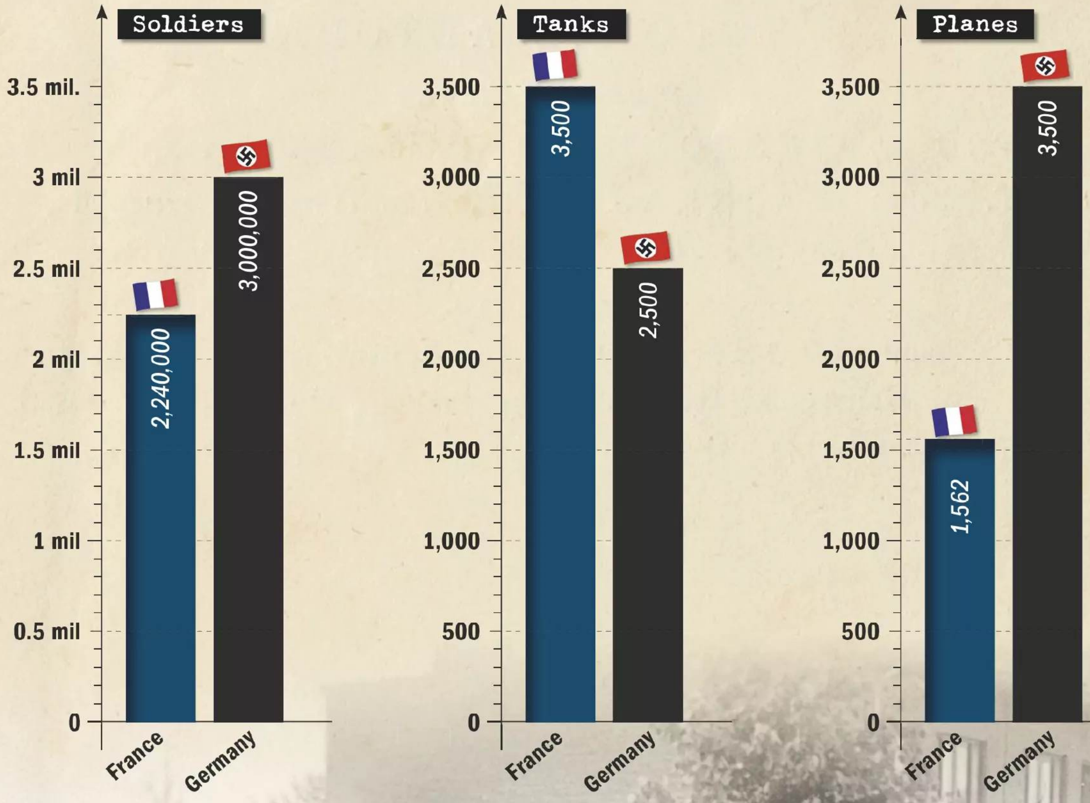
Fort's fall left France open to blitzkrieg

With the fall of Eben-Emael on 10th May 1940, Germany was free to continue its blitzkrieg advance into France. The tactic involved quickly storming through enemy defences using armoured forces and air cover.

The rapid victory in Belgium gave the Germans a psychological edge, but their superiority in the air was the Nazis' biggest advantage. Their dominance was not just down to weight of numbers – their aircraft were also technically superior to France's. The French, on the other hand, had more tanks – an advantage that they didn't fully utilise. Unlike the Germans, who grouped their tanks together in large storming divisions, the French used them as support for existing units.

German tanks were organised into special all-armoured divisions which proved to be a highly effective tactic.

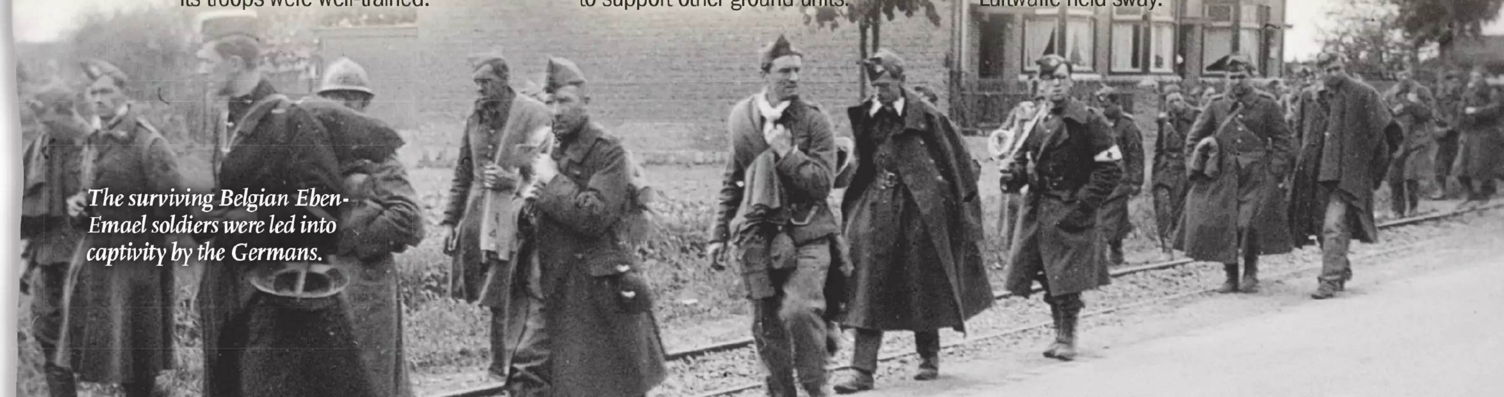
Germans had the most soldiers and aircraft



Soldiers were superior
Germany had a large army and its troops were well-trained.

Tanks used incorrectly
French tanks were usually used to support other ground units.

Luftwaffe was superior
In the air, the new German Luftwaffe held sway.



The surviving Belgian Eben-Emael soldiers were led into captivity by the Germans.

TACTICAL GERMAN OFFENSIVE

BLITZKRIEG FORCES EUROPE TO ITS KNEES

At the beginning of World War II, Germany has fewer tanks, soldiers and aircraft than France and Britain. However, Prussian General Heinz Guderian has, with Hitler's approval, developed a groundbreaking military tactic: blitzkrieg. The four-phase approach of this new strategy makes Germany's armoured divisions invincible during the first years of the war.

1940

12TH MAY

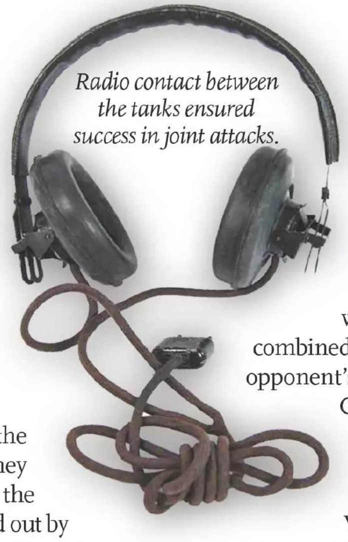
Following an initial aerial bombardment, German infantry storms the enemy's lines flanked by tanks. The assault is supported by powerful artillery guns.

Sedan, 1940

THE STAGE IS SET

Sedan
France

Hitler's armies blast through France's defences. In six weeks, the Germans have overrun one of Europe's major nations thanks to a new form of warfare. Conceived by a veteran of WWI, the new tactic is known as *blitzkrieg* (lightning war) and is based on a combination of light bombers and fast armoured divisions.


Radio contact between the tanks ensured success in joint attacks.

On 12th May, 1940, the Stuka bombers swarmed over the French trenches near the town of Sedan. Germany's invasion of France was in full swing. The air resonated with explosions and the howling sirens of small dive bombers that plunged into almost vertical dives before releasing their 250-kilogram bombs. The French soldiers at Sedan had unknowingly become the victims of history's greatest air strikes so far – and to the Germans' new blitzkrieg style of war.

The sounds of Stuka sirens shredded the nerves of the soldiers on the ground. They hunkered down into their trenches. Suddenly, the noise from the screaming Stukas was drowned out by an infernal thunder as hundreds of German artillery guns opened fire; at 15.30, a devastating bombardment began to rain destruction on what was left of the French trenches.

The shells tore the barbed wire into pieces and smashed the defender's bunkers. German planes and guns spent the next 30 minutes systematically bombing the French lines.

At 16.00, the pounding of the guns died out as suddenly as it had begun. The first tactical phase of the Germans' new lightning war was over; German reconnaissance units would now probe the defences, searching for the weakest point in the destabilised French positions.

The theory behind the new tactic had been formulated by a veteran of the WWI – Heinz Guderian – who had first-hand experience of how bloody and hopeless trench warfare could be. He realised that a massive combined attack by aircraft and tanks could break an opponent's line of defence. Hitler was thrilled with Guderian's ideas and made the tactician a general shortly after seizing power in 1933.

To ensure the success of Guderian's lightning war, Hitler developed one of World War II's most effective war machines: the armoured divisions.

Previously, the German infantry, artillery and tanks had been distributed throughout the different forces. Now they were grouped together to create devastating weapons. The divisions' mobility and their ability to exploit the strengths of their various units were the main reasons why the Germans won so many victories in the first years of the war. An individual armoured division usually consisted of 16,000 men and 3,000 vehicles. This included around 200 tanks, gathered in large groups, which could easily defeat the small, scattered clusters of tanks fielded by the enemy.

In addition to the armoured weapons, the victorious divisions were equipped with assault guns and soldiers in armoured vehicles that supported the tanks. Finally, mobile supply troops with fuel and ammunition completed the German's new war machine, which at the beginning of World War II shattered all resistance.

Armoured division breaks through

Two days after the barrage at Sedan on 14th May, 1940, General Heinz Guderian's 2nd Panzer Army blazed through the French barbed wire on the Sedan front. The day before, engineering troops in personnel carriers had declared that this was weakest point in the French line of defence – and now the heavy tanks were rolling through what was left of the enemy's fortifications.

The rotating tracks of the 200 attacking tanks churned up the ground and made the French trenches shake. Exhausted after the intense artillery bombardment and demoralised by the Stukas' screaming sirens,

NAME **HEINZ GUDERIAN**

TITLE GERMAN GENERAL

1888-1954

Prussian officer invented lightning war

Prussian officer Heinz Guderian had personal experience of failed German attempts to capture Allied trenches in northern France during WWI. His time made him realise how fast vehicles and aircraft could change war and help overrun entrenched positions. If tanks were assembled in large groups, they could break through enemy lines and secure victory. Guderian described his theories in the book *Achtung – Panzer!* and the tactics proved effective on the battlefields of Poland in 1939 and the following year in France: both countries were beaten in less than six weeks.

- **Veteran from World War I.**
- **Architect of German blitzkrieg tactics.**

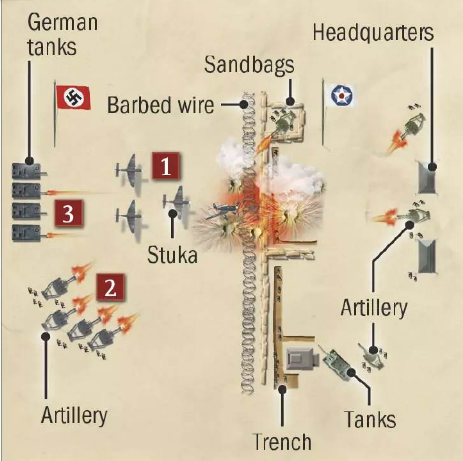
“A combined attack by aircraft and tanks could break the opponent’s lines”

Heavy German artillery shelled Soviet defences on the Eastern Front in 1942. Blitzkrieg tactics were less effective against stubborn Red Army pockets of resistance.

Four phases secured German victories

The German strategy was designed to engineer a rapid breakthrough of the opponent's lines of defence, followed by the systematic destruction of any remaining resistance among the enemy's isolated forces.

PHASE 1


German tanks
Headquarters
Sandbags
Barbed wire
1
3
Stuka
2
Artillery
Artillery
Tanks
Trench

Softening the enemy

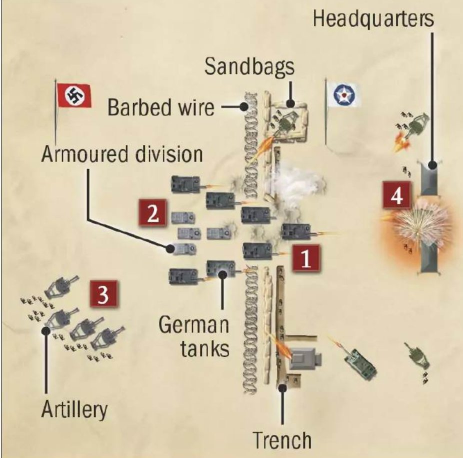
Artillery guns start a vigorous bombardment of the weakest point in the enemy's position, while dive bombers take out enemy tanks and their defences.

1 **Stukas attack** the enemy guns, tanks, bunkers and other heavily fortified defences.

2 **Artillery fires** thousands of shells against the weakest point in the enemy front line at the same time.

3 **Tanks help** with the bombardment, but successfuly stay safe from any enemy counterattacks.

PHASE 2


Headquarters
Sandbags
Barbed wire
Armoured division
2
4
1
3
German tanks
Artillery
Trench

Piercing the defence

Tank units penetrate the enemy's defence; infantry forces follow.

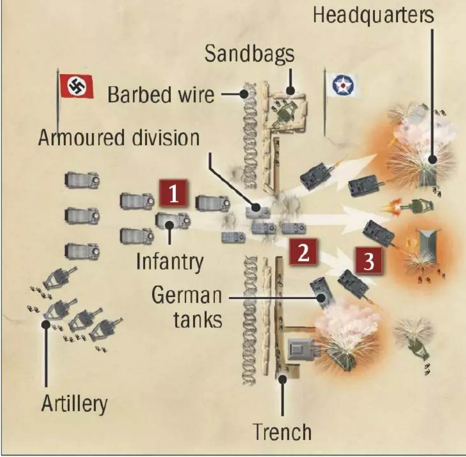
1 **Tanks assault** the weakest point in the enemy line of defence in a wedge formation. Once through, they attack enemy command centres.

2 **Soldiers in armoured** vehicles support the tanks' assault, advancing behind enemy lines to take new targets.

3 **Artillery is ready** to attack any highly fortified enemy positions.

4 **The enemy's headquarters** is relatively unprotected and vulnerable behind the front line.

PHASE 3


Headquarters
Sandbags
Barbed wire
Armoured division
1
Infantry
German tanks
2
3
Artillery
Trench

Attacking deep

Tanks continue into enemy territory, severing all communication. The troops start to surround the enemy.

1 **Troop transports** move forward. Their job is to ensure that enemy troops do not close the gap in the line of defence and cut off the attacking tanks.

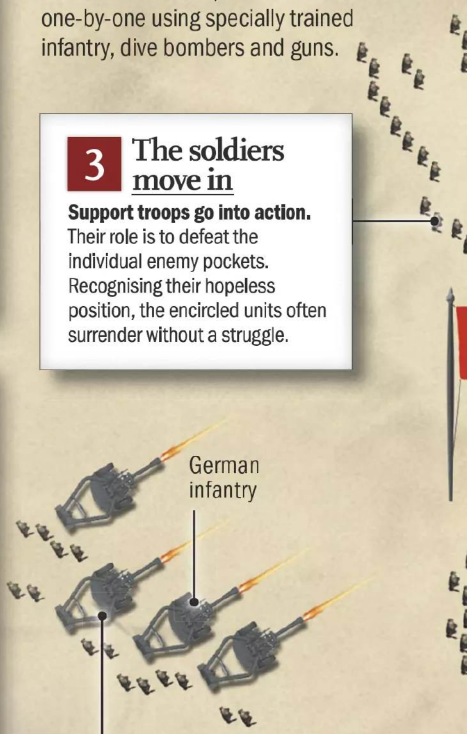
2 **Tanks attack** the enemy headquarters, disable their communication systems and create chaos and confusion.

3 **The motorised forces** spread deep behind the enemy line. Tasks include surrounding the forces manning defence installations and defeating supply troops.

PHASE 4

Fighting the enemy

The enemy forces are isolated in 'pockets' – they no longer have access to supplies or contact with the outside world. The pockets are defeated one-by-one using specially trained infantry, dive bombers and guns.

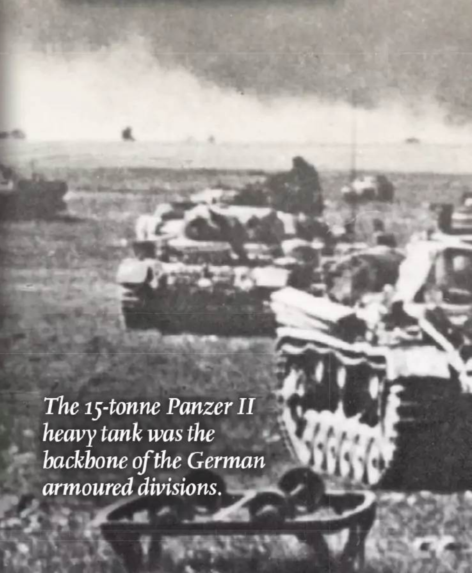

German infantry

3 The soldiers move in

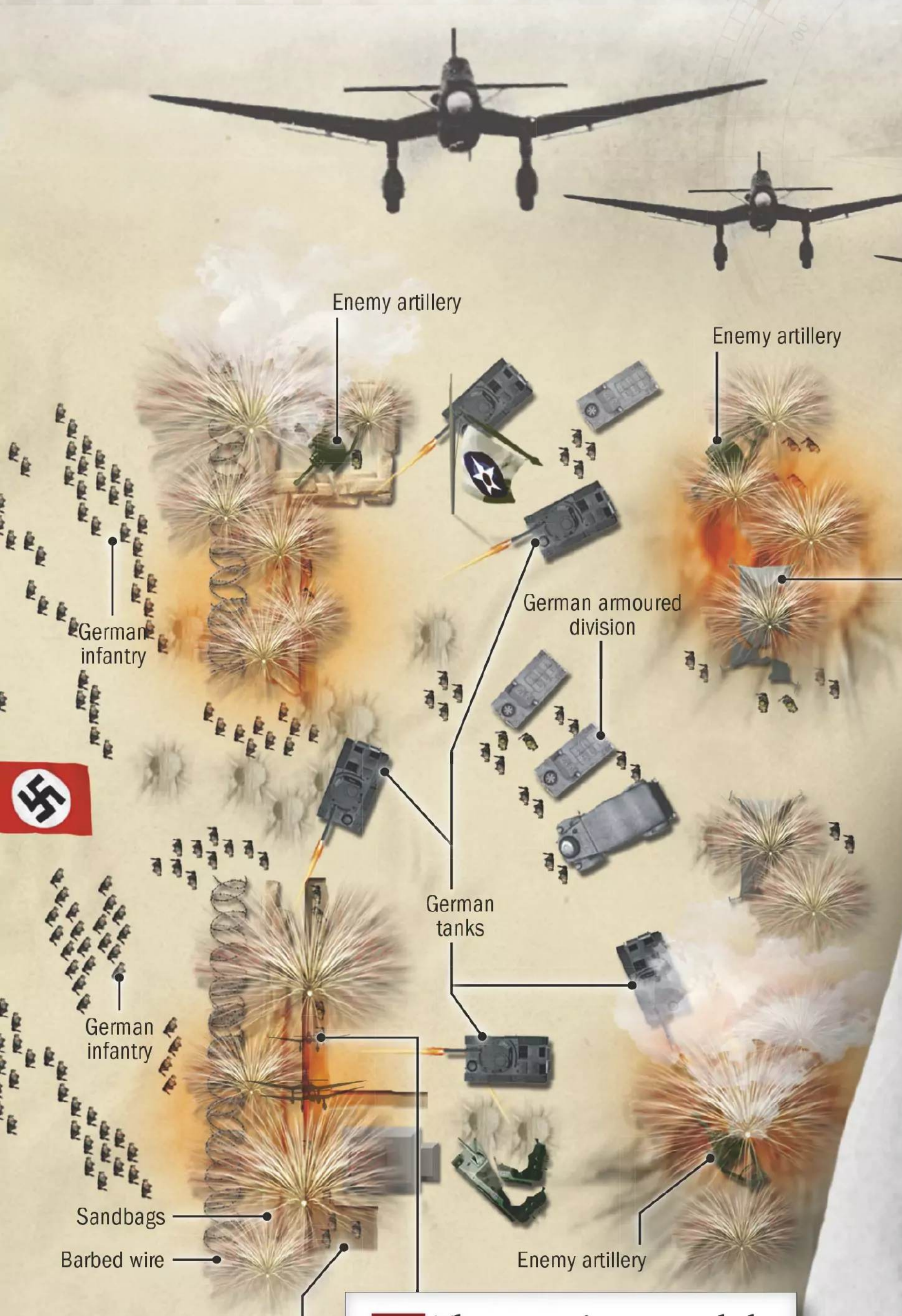
Support troops go into action. Their role is to defeat the individual enemy pockets. Recognising their hopeless position, the encircled units often surrender without a struggle.

2 Massive bombing

The artillery launches a fierce bombardment of the pockets, which is designed to weaken enemy resistance.



The 15-tonne Panzer II heavy tank was the backbone of the German armoured divisions.


Enemy artillery
Enemy artillery
German infantry
Enemy headquarters
German armoured division
German tanks
German infantry
Sandbags
Barbed wire
Trench
Enemy artillery

1 The enemy is surrounded

The enemy forces are now surrounded and locked inside a pocket, where they are cut off from communicating with the outside world and have no chance of receiving reinforcements or supplies.

Infantry that marched and fought on foot still made up the bulk of the German army during World War II.

German soldiers fight for control of one of the Maginot Line's fortifications in France in June 1940. Flame-throwers were often used to clear bunkers during the battles for these fortified positions.

German troops attack a French position in June 1940. The soldiers are supported by fire from powerful artillery units.

Waffen-SS' armoured crews wore a black cap with German eagles and Totenkopf *skull and crossbones.*

the French soldiers fled in panic. France's army commanders tried to summon reserves to plug the widening gap in their line, but the thousands of panicking soldiers were creating chaos, and their heavy tanks became stuck on the jammed roads. Meanwhile, the German tanks rolled steadfastly on through the kilometre-wide gap and German infantry established defensive positions with mortars and anti-tank guns.

The Germans storm out

French reserves marching towards the front were easy pickings for the German tanks and reconnaissance units. Stukas chased French tanks, bombing them one by one. Only 20 kilometres behind the front line, Guderian ordered his tanks to the west – behind the heavily fortified Maginot Line, which extended along the French-German border.

The German manoeuvre surrounded the French soldiers in what was supposed to be their 'impregnable' fortress. Now, they were isolated without any possibility of help. The rest of the German divisions stormed towards the English Channel, reaching it in 10 days. 400,000 Allied soldiers in north-west France and Belgium were thus cut off from their main force and unable to obtain supplies and ammunition. Trapped in a 'pocket' at the French port of Dunkirk, they were forced to escape to England in a thrown-together flotilla that included everything from warships to fishing boats.

France's army was on the point of collapse, but the final defeat of the encircled forces would come at the hands of Germany's special support troops.

Infantry **in the armoured divisions of World War II had armour-plated personnel carriers that kept them safe and could quickly move them around the battlefield.**

The Germans biggest victory

At the end of May 1940, the encircled French soldiers were fighting for their lives in the fortifications at Sedan and along the Maginot Line. The German special support units moved from bunker to bunker with flame-throwers and grenades. The prospect of dying in a hopeless battle caused the French soldiers to surrender in their thousands. Soon, the road to Paris was open, and on 25th June, 1940, France surrendered.

In just six weeks, the German armoured divisions defeated one of Europe's great powers and assuaged many Germans of the bitterness they had felt following their defeat in WWI. The French campaign was destined not only to be the Germans' first blitzkrieg, but also their greatest. The following year – during the invasion of the Soviet Union – the lightning war began to slow as the Russians fought bitterly for every pocket.

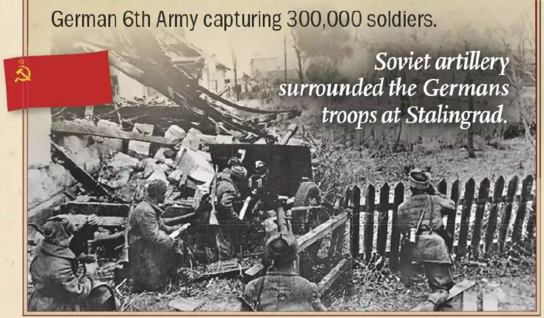
The fierce battles delayed the infantry's advance and isolated the German armoured divisions several hundred kilometres ahead of the rest of the army. The lack of fuel, ammunition and auxiliary troops ultimately halted the German advance just 20 kilometres shy of Moscow in December 1941. Guderian's blitzkrieg had finally stalled.

Allies copied blitzkrieg tactics

Following Germany's early victories, the Allies soon adopted lightning war tactics. From 1942, they fought Hitler at his own game in offenses both on the Eastern Front and on the battlefields of Western Europe. Blitzkrieg tactics are still used today when there is sufficient air and armoured strength available.

The Battle of Stalingrad

France's rapid defeat in 1940 led the US, Soviet and British military to change the structure of their armies. Then, the Allies concentrated their tanks in large units, rather than spreading them throughout their forces. From spring 1942, they also implemented the blitzkrieg four-phase approach to fight the formerly invincible German army – including at the Battle of Stalingrad, where in November 1942, the Soviets surrounded the German 6th Army capturing 300,000 soldiers.



Soviet artillery surrounded the Germans troops at Stalingrad.

Canadian armoured forces participated in the dash through France in 1944.

The outbreak from the bridgehead after D-Day

Once the Allies had landed on the Normandy coast in June 1944, they advanced rapidly. The outbreak from the bridgehead established in the north of France proceeded quickly. Aircraft and armoured units united to break the German lines and clear the path for the liberation of Paris.

Gulf wars against Iraq

Even today, Heinz Guderian's groundbreaking theories of lightning war still apply. The two Gulf Wars that were waged against Iraq in 1990-1991 and 2003 – are text-book examples of the superiority of modern warfare. The coalition first softened up the enemy with a lengthy and powerful bombardment of strategic targets, followed by a rapid armoured assault, which quickly defeated Saddam Hussein's weakened forces.

American F-16 fighters bombed Iraq during Operation Desert Storm in 1991.

BRITISH FIGHTER PLANE

SPITFIRE BATTLES MESSERSCHMITT TO VICTORY

In the 1930s, Briton Reginald Mitchell is under intense pressure to develop a fighter plane that can stand up to Hitler's powerful air force. But as the Spitfire's development is delayed again and again, the threat of a German invasion of Britain grows...

1940

20TH AUGUST

Spitfires patrolled British airspace to prevent German bombers from attacking the country during World War II.

England, 1940

THE STAGE IS SET

In 1931 the Royal Air Force has only outdated biplanes and wants a new modern fighter to defend the country against the increasing threat from Germany's Luftwaffe. The question is whether British engineers can develop a new machine to surpass Hitler's awesome Messerschmitt fighters.

BRITAIN
Southampton

THE BATTLE OF BRITAIN WAS RAGING in the airspace above Winston Churchill when the Prime Minster made his speech on 20th August, 1940: "Never in the field of human conflict was so much owed by so many to so few". Churchill directed his famous remark to the pilots of the Royal Air Force, but his praise could just as easily been aimed at the RAF's new weapon: the Spitfire.

The fighter plane with its characteristic slim profile and ellipse-shaped wings was one of the world's best fighters – both a killer and a young boy's dream. The Spitfire became crucial to the RAF's victory over the German Luftwaffe in the summer of 1940, but in fact, the plane came excruciatingly close to never making it off the drawing board. The fighter was so advanced that designer Reginald Joseph Mitchell's great and ambitious childhood dream was close to never being realised.

PLANE DESIGNER STARTED OUT BUILDING TRAINS

Mitchell was born in 1895 and was eight years old when the Wright brothers made history's first engine-powered flight in December 1903. The feat made a great impression on Mitchell, who developed a lifelong obsession with aircraft.

Mitchell wanted to work in the plane industry as a young boy. However, when he left school at the age of 16 in 1911, flight was still in its infancy, and job opportunities were limited. Instead Mitchell focussed on a career as a locomotive builder,

British factories produced nearly 23,000 Spitfire during World War II.

but when he saw a job advert from aircraft manufacturer Supermarine in 1916, he applied immediately – and got it!

Mitchell overcame his natural trepidation to head to Supermarine's Southampton factory. All he dreamed of was developing aircraft, and his enthusiasm drove him on. Thanks to his ability to mix blue-sky thinking with a grounded mind, Mitchell rose from assistant to chief engineer in the space of just a few years and his first major achievement was to build a plane that took second place in a flight competition.

Thus, the stage was set: over the following years, Mitchell designed a large number of aircraft that could start and land on water. With these planes, Supermarine won the prestigious Schneider Trophy, which was given for a race between seaplanes and flying boats, in 1927, 1929 and again in 1931. The Schneider race had captured the world's imagination since 1913, and with three wins in a row, Mitchell assured that Britain had the trophy in perpetuity.

The British winning plane from 1931 was called S.6B. At that time the record speed was 300 km/h, but Mitchell's machine set a world record with a top speed of 655 km/h. He felt ready for the call that came when the Air Ministry started looking for a replacement for the outdated Bristol Bulldog biplane fighter in 1931.

The result of his efforts became Supermarine Type 224 – a further development of the seaplane S.6B. The plane had a clumsy base, open cockpit and one set of wings. Monoplanes, as such vessels are called, were not a completely new invention, but the few which had been designed in Britain were accompanied by a swarm of stiffeners and support wires from the body to the wings, creating air resistance that prevented the planes from getting enough speed. Mitchell, however, believed that he could construct a thin wing without external stiffeners if the traditional canvas cloth was replaced with a self-supporting shell of metal.

When Type 224 took flight in February 1934, however, the plane turned out to be a disaster – especially its climb speed, which was far below the wishes of the Air Ministry.

Following the test flight, the Ministry deemed the plane did not meet its demands. The Type 224 lost out to the Gloster Gladiator, an old-school biplane with a rapidly approaching expiration date.

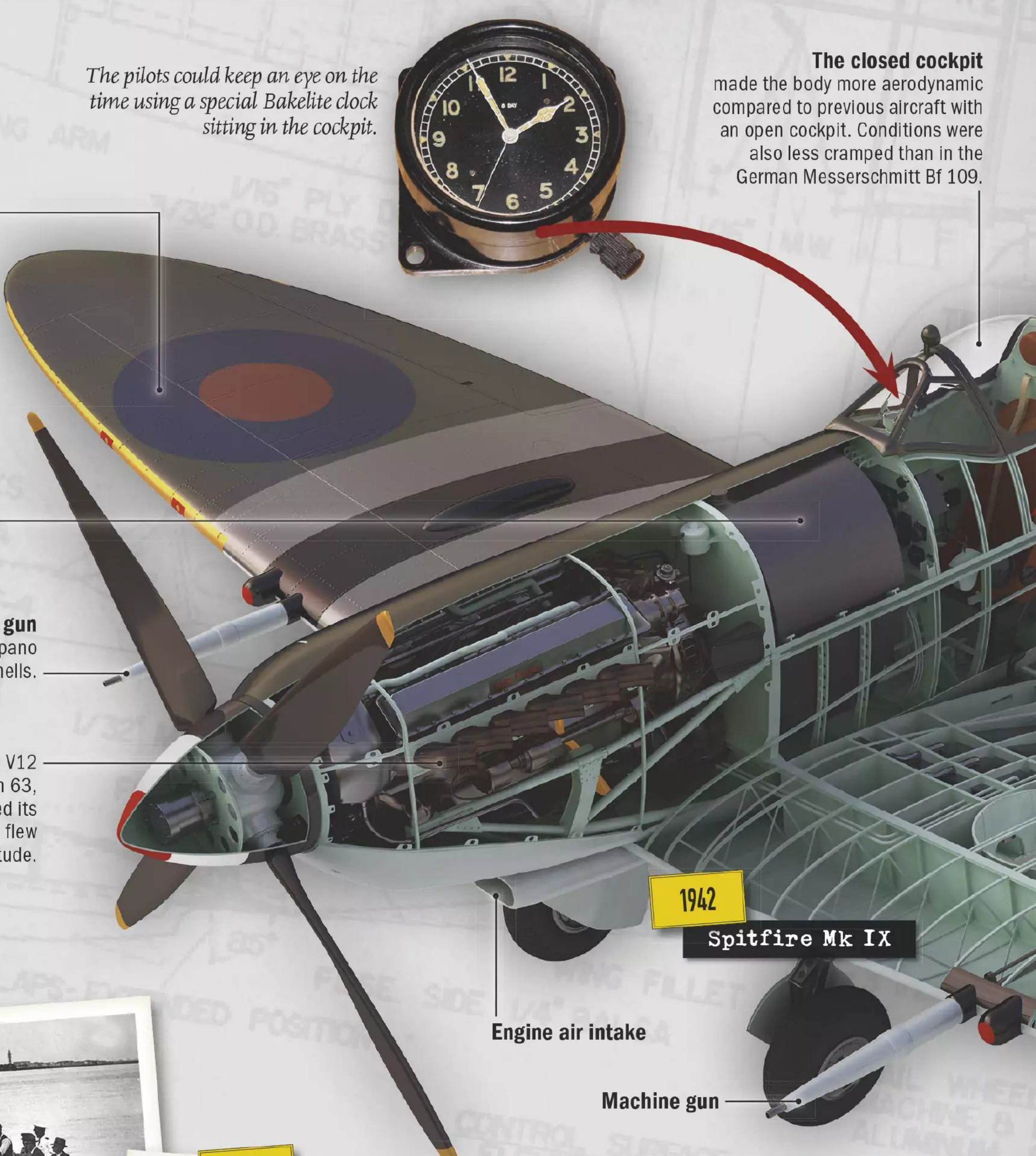
Mitchell became ill

It wasn't only in his professional life that Mitchell experienced adversity; in the summer of 1933 while working with the Type 224 he was hospitalised with

A RAF pilot's emergency equipment included a life jacket.

Spitfire was like a ballerina in flight

Britain's new fighter plane – Spitfire – was produced in 24 different versions with different engines and wings, but common to all of them was their superb manoeuvrability.



The pilots could keep an eye on the time using a special Bakelite clock sitting in the cockpit.

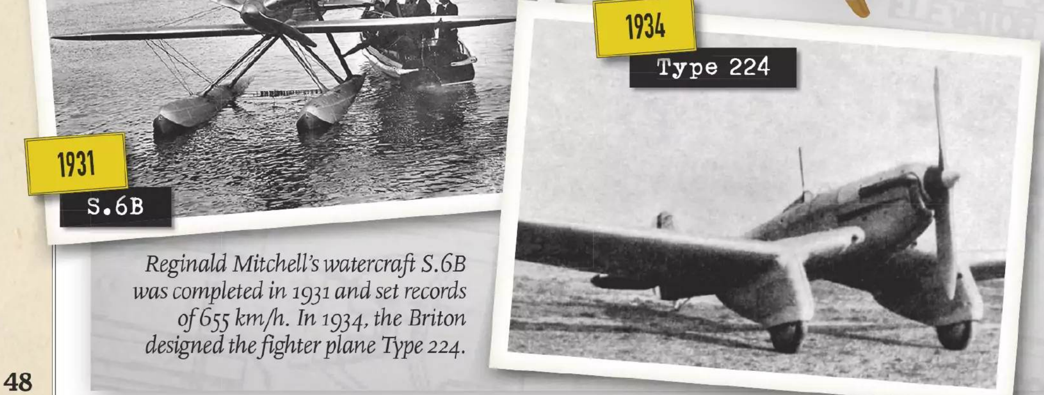
The closed cockpit made the body more aerodynamic compared to previous aircraft with an open cockpit. Conditions were also less cramped than in the German Messerschmitt Bf 109.

The forward tanks contained about 320 litres of fuel. When full, the Spitfire could fly up to 1,900 kilometres.

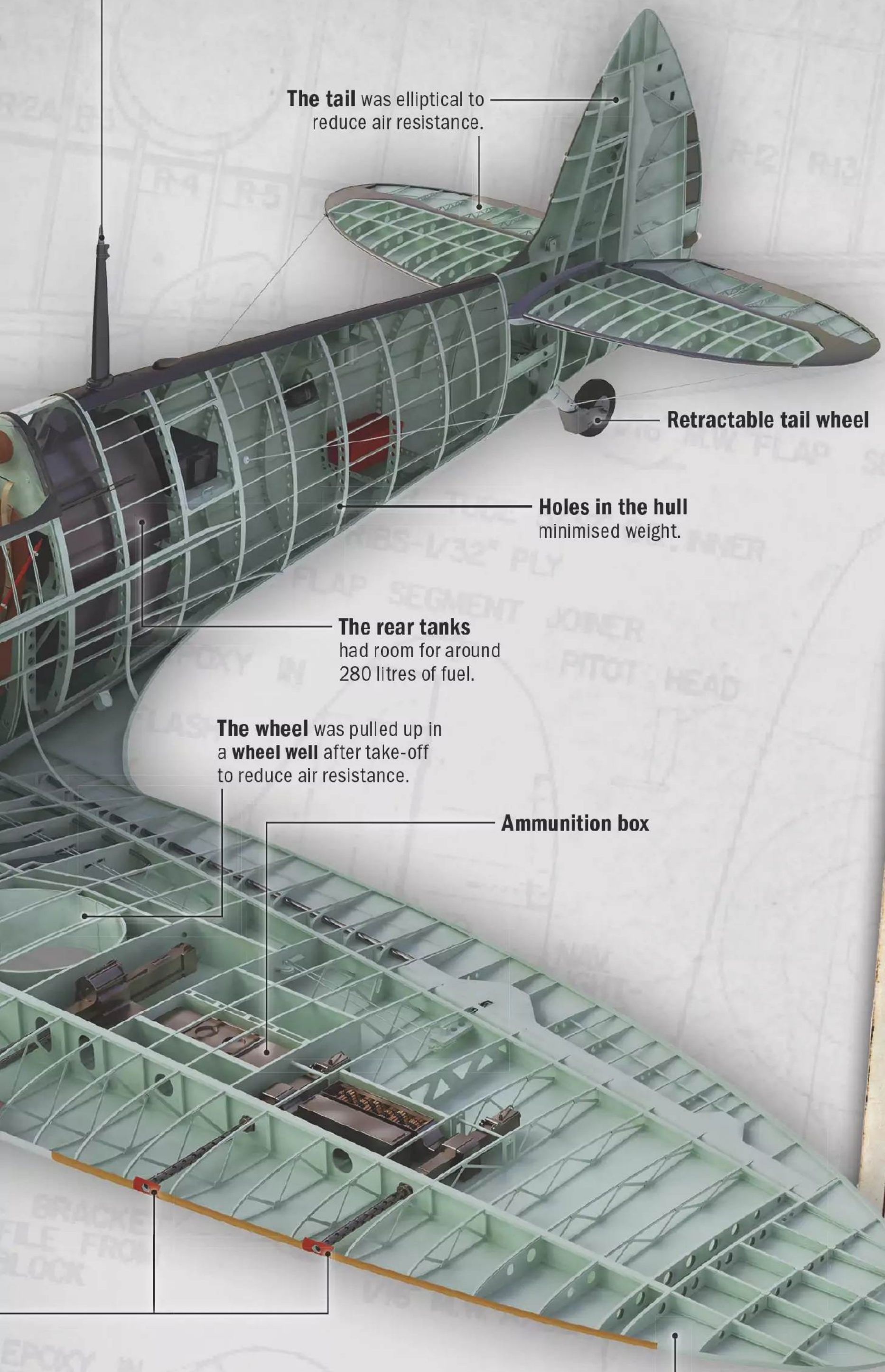
The machine gun was branded Hispano and fired 20-mm shells.

The engine – a V12 Rolls-Royce Merlin 63, 1,712 hp – performed its best when the plane flew at high altitude.

Browning machine guns were standard armaments in Spitfire aircraft. Flaps covered them so the weapon did not freeze before it was fired.



Reginald Mitchell's watercraft S.6B was completed in 1931 and set records of 655 km/h. In 1934, the Briton designed the fighter plane Type 224.



The radio antenna was aerodynamically shaped.

The tail was elliptical to reduce air resistance.

Retractable tail wheel

Holes in the hull minimised weight.

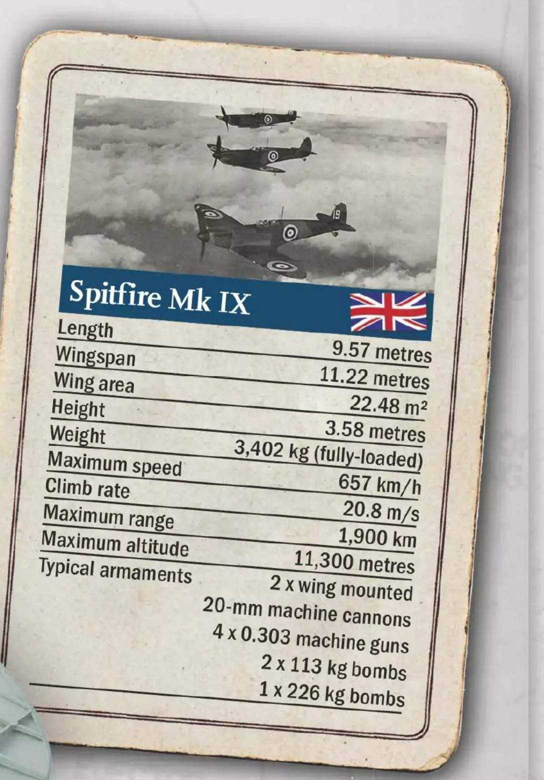
The rear tanks had room for around 280 litres of fuel.

The wheel was pulled up in a **wheel well** after take-off to reduce air resistance.

Ammunition box

The elliptical wing was one of Mitchell's most ingenious ideas because it reduced air resistance and also provided space for landing gear and weapons.

Cockpit light openings could be adjusted to give the right amount of light.



Spitfire Mk IX

Length	9.57 metres
Wingspan	11.22 metres
Wing area	22.48 m²
Height	3.58 metres
Weight	3,402 kg (fully-loaded)
Maximum speed	657 km/h
Climb rate	20.8 m/s
Maximum range	1,900 km
Maximum altitude	11,300 metres
Typical armaments	2 x wing mounted 20-mm machine cannons 4 x 0.303 machine guns 2 x 113 kg bombs 1 x 226 kg bombs

Prime Minister Winston Churchill boosted worker morale during visits to Spitfire plants.

colon cancer. Even though the Briton returned to work at Supermarine in spring 1934, doctors warned him that the cancer could return at any time.

But Mitchell did not stop and continued his passion: to build a plane. After his return, the aircraft developer immediately decided to convert Type 224 into a winner. The body itself was aerodynamically sound, but the rest of the plane had to be changed: the clumsy landing gear was replaced with a retractable undercarriage that could be pulled up into the wing, the open cockpit replaced by an enclosed one, and the wing structure changed radically.

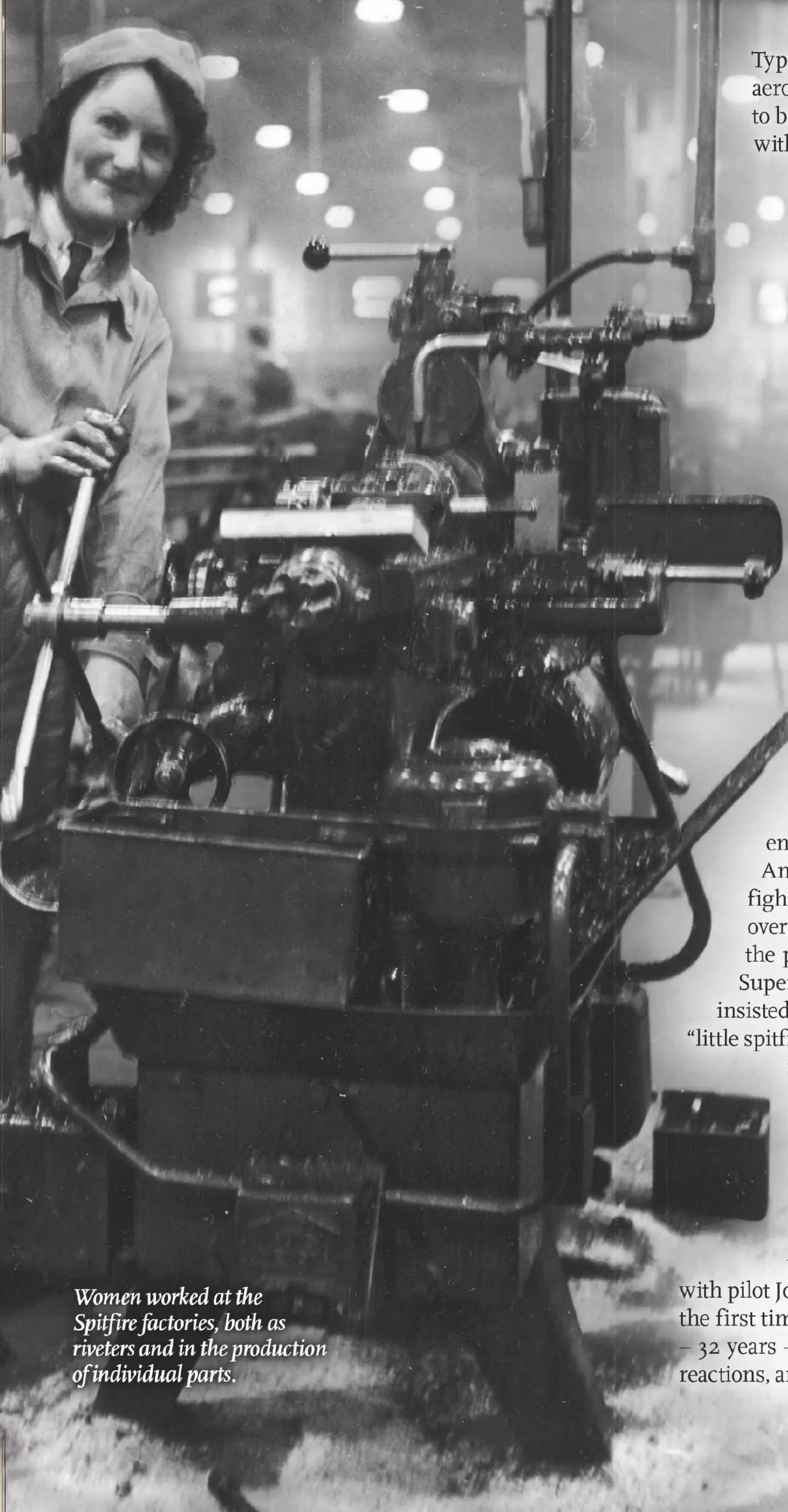
Mitchell's vision was that the plane should be armed with four machine guns under each of the wings – an unprecedented reinforcement at the time. To create the necessary space, the Briton created a thin, elliptical wing, which also added excellent aerodynamic properties to the aircraft.

The challenge was to find an engine that gave the plane enough power. A proper engine was required if the fighter was to measure up against the fighters that were under development in Germany and elsewhere. Mitchell had a good collaborative relationship with Rolls-Royce, and once again the factory delivered a powerful engine – a V12 with over 1,000 horsepower.

Among the names that were in play for the new fighter were "Shrew" or "Scarab" but both were overruled – however, Mitchell was indifferent to what the plane was called. Robert McLean, the director of Supermarine's parent company, Vickers-Armstrong, insisted that the aircraft should be called Spitfire, after his "little spitfire" of a daughter; it had also been assigned to the rejected Type 224.

When Mitchell learned that the director was fixated on the name Spitfire, he thought that it was "cursed to name the plane after a previous failure". He preferred to refer to his vessel as "The Plane" or "Type 300".

Mitchell was finally ready to let the Spitfire take flight for the first time in spring 1936, and with pilot Joseph Summers at the controls, the plane flew for the first time on 5th March. Despite his relatively young age – 32 years – Summers was a seasoned pilot with lightning reactions, and people said he could fly a kitchen table if it only



Women worked at the Spitfire factories, both as riveters and in the production of individual parts.

had a propeller. With Summers in the cockpit, the Spitfire behaved like a dream, and when he landed eight minutes later, he was surrounded by an avid crowd who turned up to hear what he thought. As he took off his helmet, Summers was firm in his assessment:

"Don't touch a single thing". In short, the pilot was excited and in agreement with the Air Ministry delegates who attended the test flights. It appeared Britain had something that surpassed anything the Germans had yet built.

AIRCRAFT PASSED THE TEST

At the end of May 1936, the Spitfire would undergo a major trial with the Air Ministry, which had plans to incorporate the fighter plane into the Royal Air Force. Captain Humphrey Edwardes-Jones was appointed as the pilot to determine the plane's destiny.

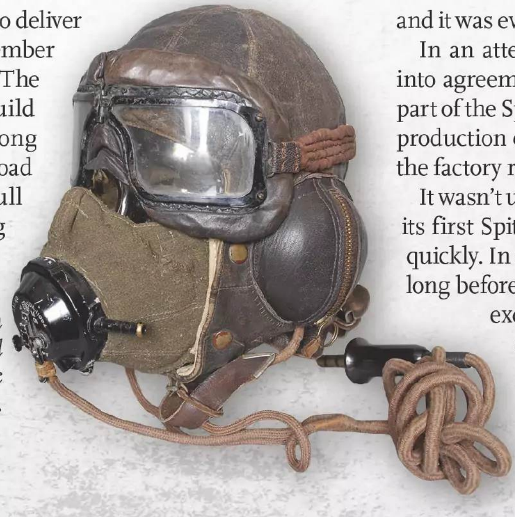
The flight ran smoothly, and immediately after landing, Edwardes-Jones went to see Wilfrid Freeman from the Air Ministry to share his immediate opinion on the plane. He had barely uttered a word before he was interrupted. "All I want to know now is whether you think the young pilot officers will be able to cope with such an advanced plane", Freeman asked. "Yes", replied Edward Jones. Shortly afterwards, Freeman made an order for 310 Spitfires, the first of which was to be delivered in September 1937 and the last in March 1939.

During the spring and summer of 1936, the Spitfire charmed the English population with a series of shows, and from all sides the plane was flooded with praise. People were in awe of the fighter plane's beautiful clean lines, and connoisseurs were excited by its acrobatic skills, calling it "a ballerina in flight". Even the industry magazine *Flight*, which wasn't known for its enthusiastic superlatives had to give in: "It is claimed – and the claim seems indisputable – that the Spitfire is the fastest military plane in the world".

Mitchell had hardly any strength left to accept the accolade he was receiving. The cancer had returned with renewed force, and by the end of 1936 Mitchell was very weak. But even though his life was a painful hell, he went to his office daily to muse over Spitfire drawings. In the spring of 1937, his health deteriorated further. On 6th June, 1937, he slipped into unconsciousness, and five days later, he died at the age of 42. At the funeral, three RAF aircraft flew in formation over the cemetery in Southampton and tipped their wings as a gesture to the man who had designed the ground-breaking Spitfire.

PILOTS LOVED NEW FIGHTER

Supermarine's promise to deliver the first aircraft by September 1937 proved unrealistic. The Spitfire's all-metal build made it unique among British aircraft, so its road from prototype to full production was a long one. The situation wasn't helped as Supermarine had never tried to build aircraft in such large numbers before. To the Air Ministry's deep frustration, Supermarine delayed the date of the first delivery.

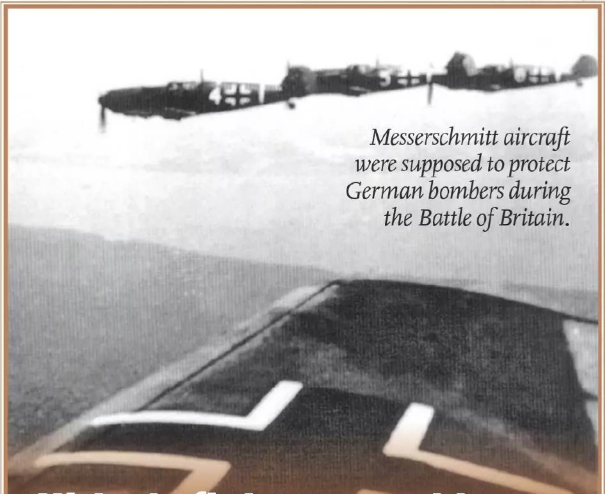


A leather helmet with built-in microphone and goggles were part of the pilot's standard equipment.

Nevertheless, in the spring of 1938, the Ministry increased the order from 310 to 510 planes. The need to get the planes up and running was critical – Hitler was no longer hiding his ambitions. In March 1938 German troops marched into Austria. The Führer threatened to occupy Czechoslovakia, and it was evident that a big European war was on the horizon.

In an attempt to boost production, Supermarine entered into agreements with a host of subcontractors to build each part of the Spitfire. Almost 80 companies were engaged in the production of wings, tail pieces and engine suspension. Yet, the factory remained hopelessly behind schedule.

It wasn't until 4th August, 1938 that Supermarine delivered its first Spitfire to the RAF, but then other aircraft followed quickly. In spite of the wait, pilots were thrilled, and it wasn't long before the plane had gained glory as rumours about its excellence spread far and wide. Pilots spoke with awe about the Spitfire, and for many Britons,the fighter became their main reason for enlisting with the RAF.



Messerschmitt aircraft were supposed to protect German bombers during the Battle of Britain.

Hitler's fighters could not overcome the Spitfire

Although the Messerschmitt Bf 109 was more heavily armed and flew higher and faster than the Spitfire, it could not beat its British rival.

On paper, the German Messerschmitt Bf 109 fighter should have been the Spitfire's superior. Its powerful weapons, high speed and high altitude made the plane a terrifying opponent. With its direct fuel injection, Messerschmitt Bf 109 provided a smooth flight, whereas the Spitfire's engine coughed and spluttered due to its carburettor system.

On the other hand, the manoeuvrability of British fighters was unmatched. Under pressure, the pilot could shake off his opponent by performing a half roll, following up quickly with a dive.

One such example was HR Allen, who applied to be a pilot immediately after seeing a picture of the plane:

"It was an aircraft quite out of this world", he enthused, and after his debut flight in a Spitfire, Allen was not disappointed.

"If you wanted to turn, you just moved your hands slowly and she went. She was really the perfect flying machine", was the view echoed by George Unwin, who flew with 19 Squadron. He was far from alone in his admiration for the fighter. It was as if man and machine melded into one.

A sense of connectivity was highlighted by several pilots, and as one of them, Bob Doe, said:

"You're not flying an aeroplane; you've got wings on your back".

The Spitfire's manoeuvrability was in a class of its own compared to other RAF planes. Goodson described how the plane's manoeuvrability made it a pleasure to smoke – though smoking was strictly forbidden on board:

"If I drop my cigar, instead of groping around on the floor, I'd move the stick a fraction of an inch, the Spit would roll over and after that I'd catch the cigar as it came down from the floor".

Soon, however, enthusiasm was replaced by the bloody realities of war as the Germans began air raids over England in 1940.

GERMANS WERE HUMILIATED BY THE BRITISH

After the outbreak of World War II in September 1939 Germany marched from victory to victory, and only the British stood on the way of a Europe united under Hitler. The Germans therefore planned to invade Britain, and the first step was to gain air superiority and crush the RAF. The Germans considered the task doable – until they saw the Spitfire in action.

On paper, the British faced certain defeat in any test of strength against the Germans, as the Luftwaffe was the superior of the RAF in terms of both men and equipment. But when German bombings escalated on 10th July, 1940, and German fighters approached the British coast for what would develop into the first major air battle in history, they were met by a swarm of Spitfire and Hawker Hurricane fighters.

The two types of fighter were more than a match for the Luftwaffe's heavy bombers, and as the Battle of Britain progressed, the Germans had to face the fact that they had underestimated the RAF pilots and their machines.

The Germans even had an advanced fighter, the Messerschmitt Bf 109, which was both faster and more heavily armed than the Spitfire – yet when it came to manoeuvrability, the new British aircraft was incomparable. The plane became the symbol of victory in the Battle of Britain – in combination with the so-called Dowding system, a network of radar and flight observers, the Spitfire successfully defended Britain.

For the Germans, on the other hand, the Spitfire became synonymous with total humiliation. When the head of Luftwaffe, Hermann Göring, asked one of his very best pilots what he thought was needed to turn the tables, he received a response that left him red with rage:

"Give me a squadron of Spitfires".

NAME **REGINALD MITCHELL**

TITLE AIRCRAFT DESIGNER

1895-1937

German trip inspired plane

Not many people would have thought that Reginald Mitchell would become one of Britain's greatest aircraft engineers when he apprenticed with locomotive manufacturer Kerr Stuart & Co, aged 16. The inquisitive boy, however, took the time to absorb as much technical knowledge as possible. Mitchell worked in the company's drawing room at the end of his apprenticeship and took concurrent technical and math courses at night school. With his new skills in the bag, the young Briton was perfectly placed to apply for a position at the Supermarine aircraft manufacturer, where he quickly rose from assistant to chief engineer.

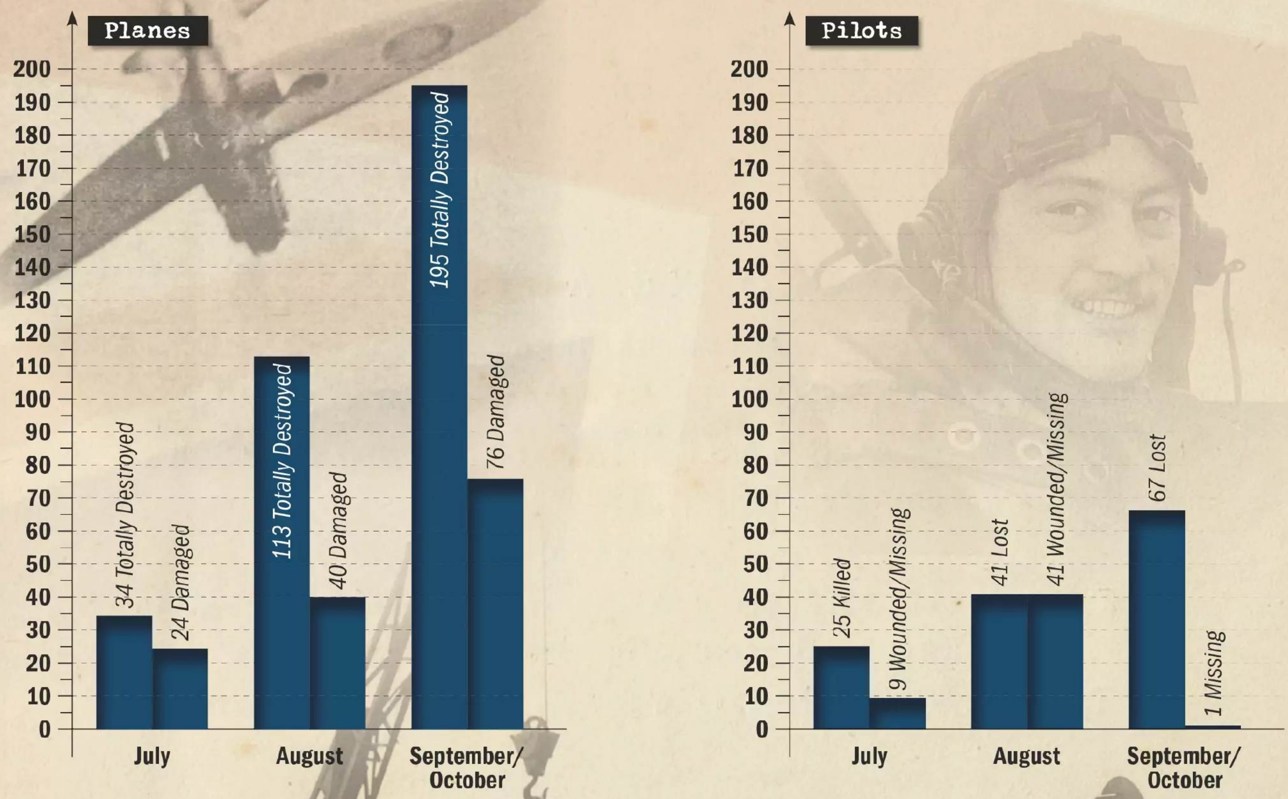
After being diagnosed with cancer, Mitchell travelled to Germany in 1934. Here, the aircraft engineer realised that the RAF was no match for the Luftwaffe, and he recognised that Britain had to create a powerful fighter plane to counter any German attack.

- **Qualified as a pilot in 1934.**
- **Had a school named after him in 1989.**

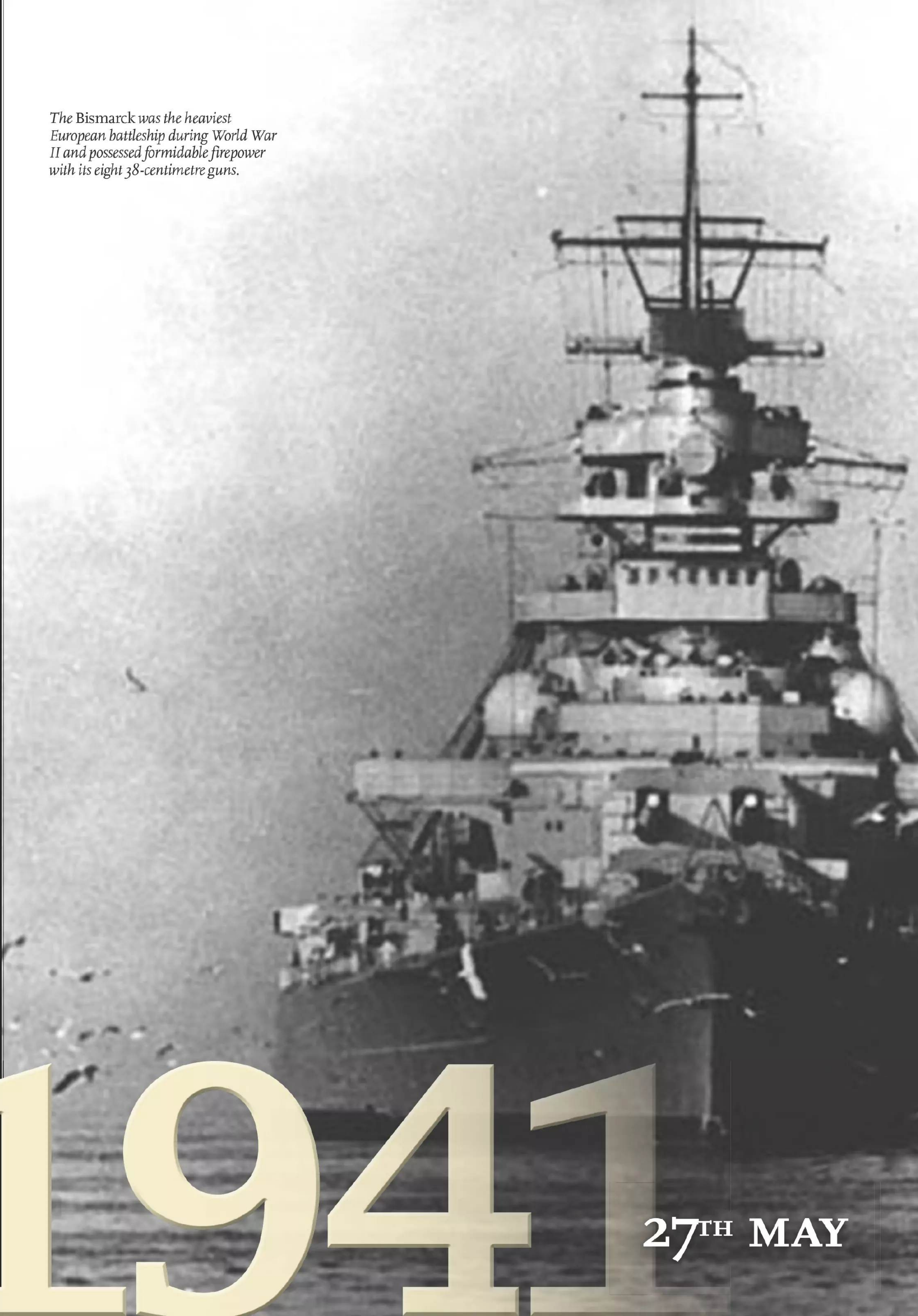
One in three British fighter pilots killed sat in a Spitfire

During the Battle of Britain in 1940, the loss of both Spitfires and pilots grew month by month. Nearly a third of all British fighter pilots who died during the four-month battle were in a Spitfire. The Luftwaffe lost a total of 1,887 planes and 2,662 crew during the air attacks.

Loss of Spitfires during the Battle of Britain



A total of 482 Spitfire were either damaged or completely destroyed during the Battle of Britain.



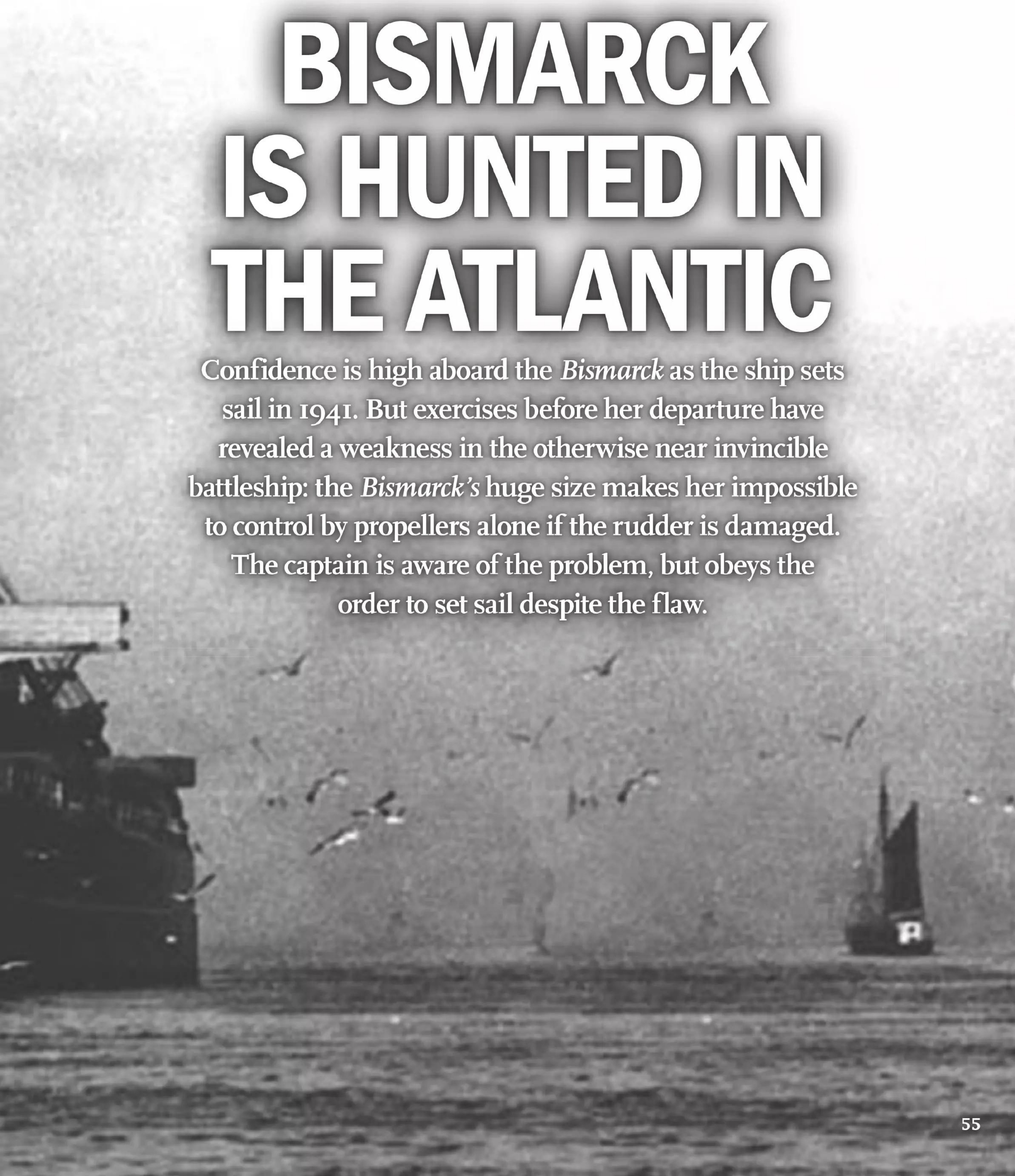
The Bismarck *was the heaviest European battleship during World War II and possessed formidable firepower with its eight 38-centimetre guns.*

1941

27th MAY

BISMARCK IS HUNTED IN THE ATLANTIC

Confidence is high aboard the *Bismarck* as the ship sets sail in 1941. But exercises before her departure have revealed a weakness in the otherwise near invincible battleship: the *Bismarck's* huge size makes her impossible to control by propellers alone if the rudder is damaged. The captain is aware of the problem, but obeys the order to set sail despite the flaw.



North Atlantic 1941

THE STAGE IS SET

ICELAND
BRITAIN

When she sets sail for her first mission in the spring of 1941, the German's brand-new battleship, the *Bismarck*, is one of the most powerful in the world. The British know that the mighty vessel will pose a severe threat to Allied convoys if she reaches the Atlantic and will do anything to stop her.

THE BATTLESHIP *BISMARCK* BASKED in the May sun as she lay in the Norwegian Grimstad Fjord. On deck, 30-year-old Lieutenant Baron Burkard von Müllenheim-Rechberg, was one of the carefully selected crew members assigned to sail on the new vessel, the pride of Germany's navy. He was convinced that the *Bismarck*, which was under the captaincy of Ernst Lindemann, could handle any mission.

150,000 horsepower was provided by the *Bismarck's* 12 large boilers, the equivalent of c. 100 artillery tanks. Power came via three large-bladed propellers.

The two German Messerschmitt fighters that circled the ship as a defence against British bombers increased his sense of security. Throughout the day, the *Bismarck* had been visited by military personnel admiring the Third Reich's sleek naval engineering. The ship's first gunnery officer, 37-year-old Adalbert Schneider, proudly showed his brother around the ship. "We're stronger than anything faster and faster than anything stronger," he said before adding, "Our assignment is just like life insurance."

It was 21st May 1941, two days after the *Bismarck* had set sail as part of Operation Rheinübung. The mission was being overseen by Admiral Günther Lütjens, who was also aboard the *Bismarck*. Its objective was to sail undetected into the Atlantic with the heavy cruiser *Prinz Eugen* to sink as many of Britain's vital supply convoys as possible. The convoys had an escort of British warships, but they would be defenceless against the *Bismarck*'s superior firepower.

At 13.00, an air siren broke the day's quiet. Air defence teams were put on high alert, but when no planes appeared, it was assumed to be a false alarm. The crew breathed a sigh of relief.

High above, the British pilot whose plane had triggered the warning was already on his way home with pictures of the *Bismarck* and the *Prinz Eugen*. The images confirmed Swedish intelligence: the *Bismarck* had left its port in occupied Poland. The cruisers *Norfolk* and *Suffolk* were immediately ordered to patrol the Denmark Strait between Iceland and Greenland, and three cruisers were sent to guard the waters between Iceland and the Faroe Islands. The mighty battle cruiser *Hood*, the battleship *Prince of Wales* and six destroyers patrolled the waters south of Iceland.

The following evening a reconnaissance plane returned with important news: the Germans had left Norway. HMS *King George V* set out from Scotland, accompanied by the aircraft carrier *Victorious*, four cruisers, three destroyers and the old battle cruiser *Repulse*. The hunt had begun.

HIDING IN THE FOG

The following day, 23rd May, the *Bismarck* and *Prinz Eugen* sailed at high speed down the Denmark Strait. On the

There was a sense among the crew – which numbered around 100 officers and 2,100 seamen – that the ship was almost invincible.

starboard side, blue-white pack ice glistened before a backdrop of towering Greenland glaciers. To port, a heavy haze masked the horizon towards Iceland.

The scenery was so beautiful that Müllenheim-Rechberg found it hard to tear himself away from the view, but the idyll was broken abruptly at 18.11, when the alarm sounded: the *Bismarck*'s hydrophones had detected vessels to starboard, but it was another false alarm. At 19.22 the bells rang again, this time signalling a contact on the port side. Moments later, the silhouette of a massive superstructure with three stacks slipped past them in the fog: it was the HMS *Suffolk*.

The British cruiser turned as the *Bismarck* sped away and began tailing the German ship at a safe distance. At 20.30, the alarm sounded again. The *Bismarck*'s radar had detected another British cruiser, the *Norfolk*, ahead. The Germans' guns flashed as they fired, but the British laid down a smokescreen and disappeared quickly into the fog only to reappear behind the two German ships shortly afterwards.

The recoil from the huge guns had put the *Bismarck*'s forward radar out of action. The *Prinz Eugen*, which had no radar problems, was ordered to switch places and take over the lead position. The *Bismarck*'s more powerful guns could now cover the two enemy ships tailing them. Müllenheim-Rechberg, who was ordered to the rear gunnery to observe the enemy vessels, soon discovered that neither speed nor concealment were enough to shake their pursuers. The *Bismarck* raced through the bright Arctic night at almost 30 knots, constantly changing course and seeking shelter in any available fog bank, but the British were equipped with highly efficient radar. The hunt went on all night, and aboard the *Bismarck* concerns mounted about which other ships may have been alerted.

1894-1941

NAME **ERNST LINDEMANN**

TITLE CAPTAIN

Leader was popular with his men

Ernst Lindemann had worked his way up through the German naval ranks and was well liked by his crew because of his friendly and caring manner. The captain preferred to refer to the *Bismarck* as 'he' rather than 'she', as he thought the ship was too powerful to be female.

- **Joined the fleet in 1913.**
- **Became the ship's captain in 1940.**

1889-1941

NAME **GÜNTHER LÜTJENS**

TITLE ADMIRAL

Reserved admiral refused to 'heil'

The tight-lipped Lütjens was in command of Operation Rheinübung on the *Bismarck*, which led to friction with Lindemann. Lütjens was also at odds with the high command: he refused to give the Nazi salute when Hitler toured the *Bismarck* before her departure.

- **Decorated in World War I.**
- **Made full admiral in 1940.**

Ships attacked like angry bulls

At 05.45 the answer came: first two columns of smoke appeared against the brightening horizon to the south-east, then two masts. Looking through a director rangefinder, Müllenheim-Rechberg could soon see the complete silhouette of two large warships, thundering towards the *Bismarck*. They reminded him of charging bulls, totally blind to what they were up against. At 05.53 the distance was down to 20 kilometres, and suddenly he saw a gigantic flash of light from the ships. The enemy had opened fire.

Britain's largest warship, the *Hood*, was heading directly for the *Bismarck*, with salvoes bursting from her guns. The Germans couldn't have asked for a more worthy opponent.

The *Bismarck*'s first volley exploded with a bang that could be heard from Reykjavík, several hundred kilometres away. With amazing speed the Germans fired at HMS *Hood*. The men in the four gun turrets sent off one shell after another. Müllenheim-Rechberg, who should have been focussing on watching for a possible attack from the two British cruisers behind, had a hard time keeping his eyes off the exchange.

British pride sinks below the waves

When First Gunnery Officer Schneider calmly announced that "the enemy is burning", it was too much for Müllenheim-Rechberg: he handed over rearwards surveillance to a subordinate and rushed over to look through the port director facing the *Hood*. While he searched for the British battle cruiser, he heard the cry, "She's blowing up!" The men aboard the *Bismarck* looked at one another in disbelief. When Müllenheim-Rechberg finally trained his rangefinder on the *Hood*, all he could see was a column of black smoke, and at its foot something incredible: the *Hood*'s bow pointing upwards at a sharp angle. The ship had broken in two.

In just six minutes the *Bismarck* had sunk Britain's proudest warship. Once the shock had subsided, cheers broke out among the crew. The men excitedly slapped one

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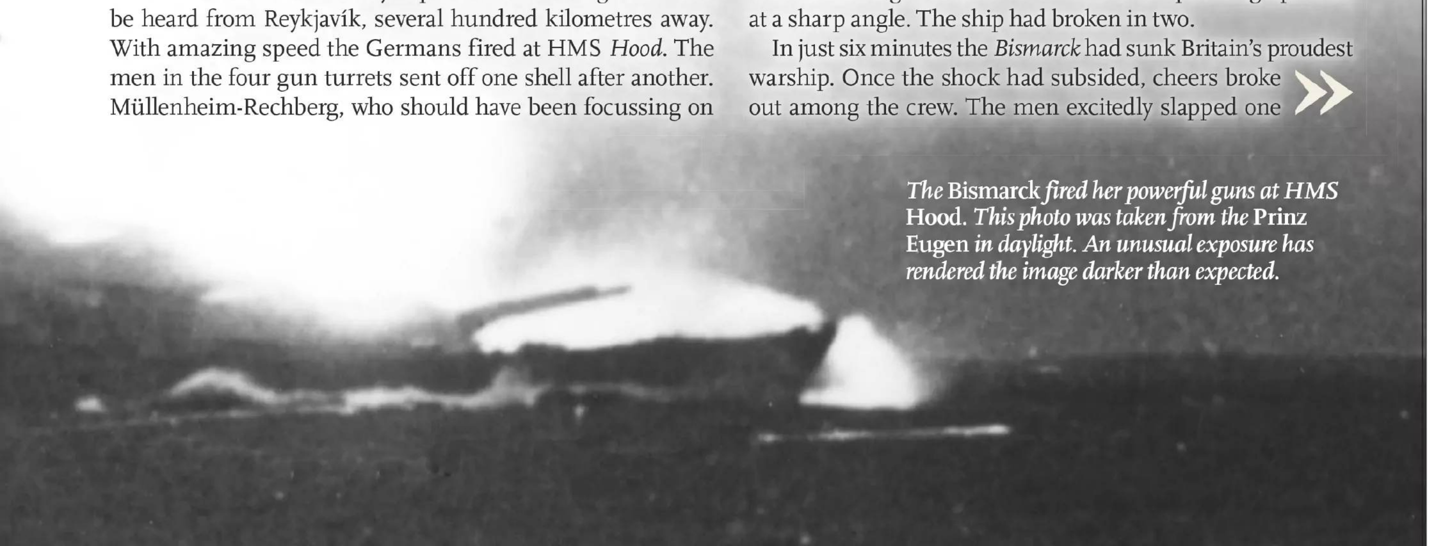
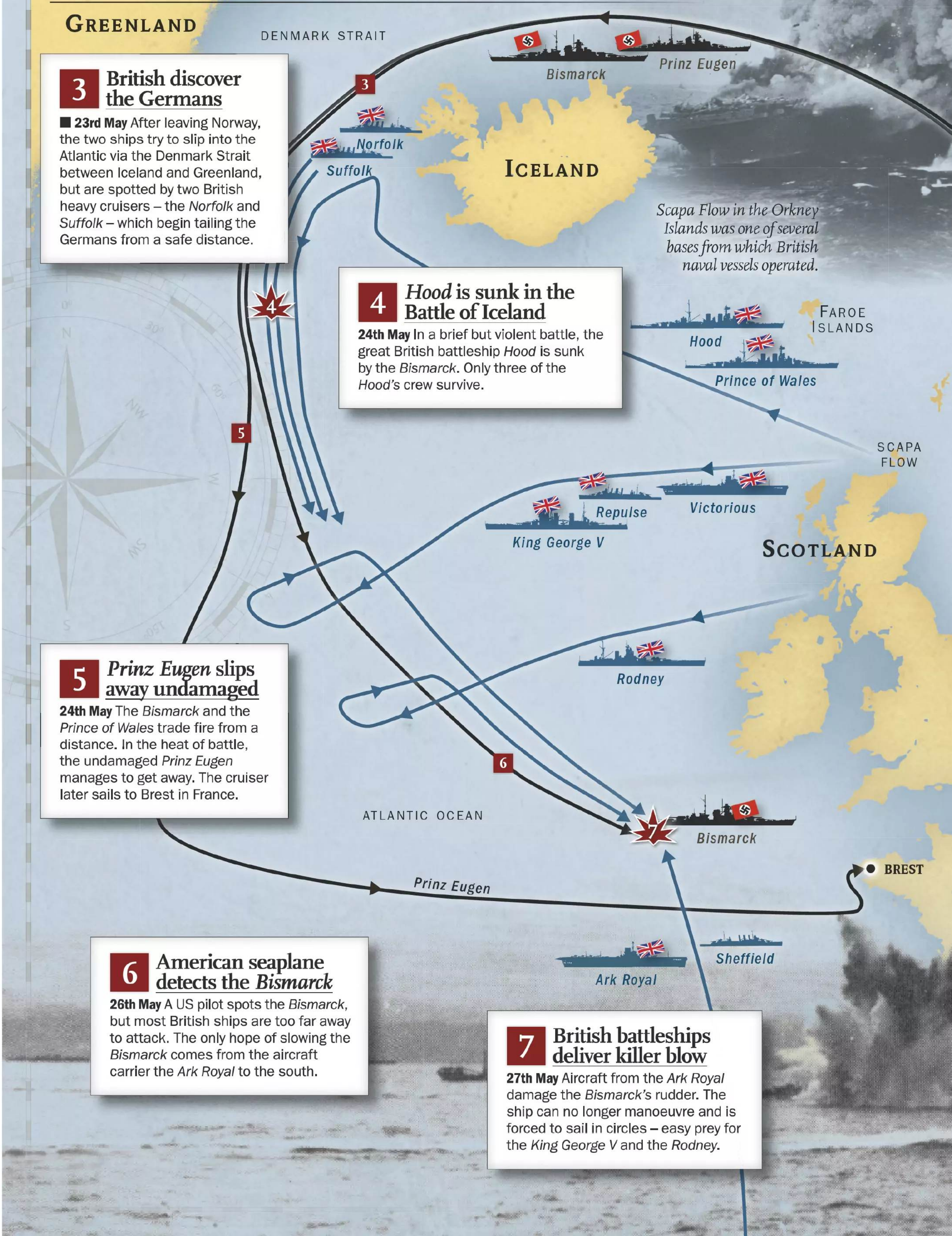


The Bismarck *fired her powerful guns at HMS* Hood. *This photo was taken from the* Prinz Eugen *in daylight. An unusual exposure has rendered the image darker than expected.*

Hungry pack hunted the Bismarck

The German ship was shadowed by destroyers and monitored by aircraft. Despite her speed, the *Bismarck* never managed to escape the Royal Navy.



3 British discover the Germans

■ **23rd May** After leaving Norway, the two ships try to slip into the Atlantic via the Denmark Strait between Iceland and Greenland, but are spotted by two British heavy cruisers – the *Norfolk* and *Suffolk* – which begin tailing the Germans from a safe distance.

Scapa Flow in the Orkney Islands was one of several bases from which British naval vessels operated.

4 *Hood* is sunk in the Battle of Iceland

24th May In a brief but violent battle, the great British battleship *Hood* is sunk by the *Bismarck*. Only three of the *Hood's* crew survive.

5 *Prinz Eugen* slips away undamaged

24th May The *Bismarck* and the *Prince of Wales* trade fire from a distance. In the heat of battle, the undamaged *Prinz Eugen* manages to get away. The cruiser later sails to Brest in France.

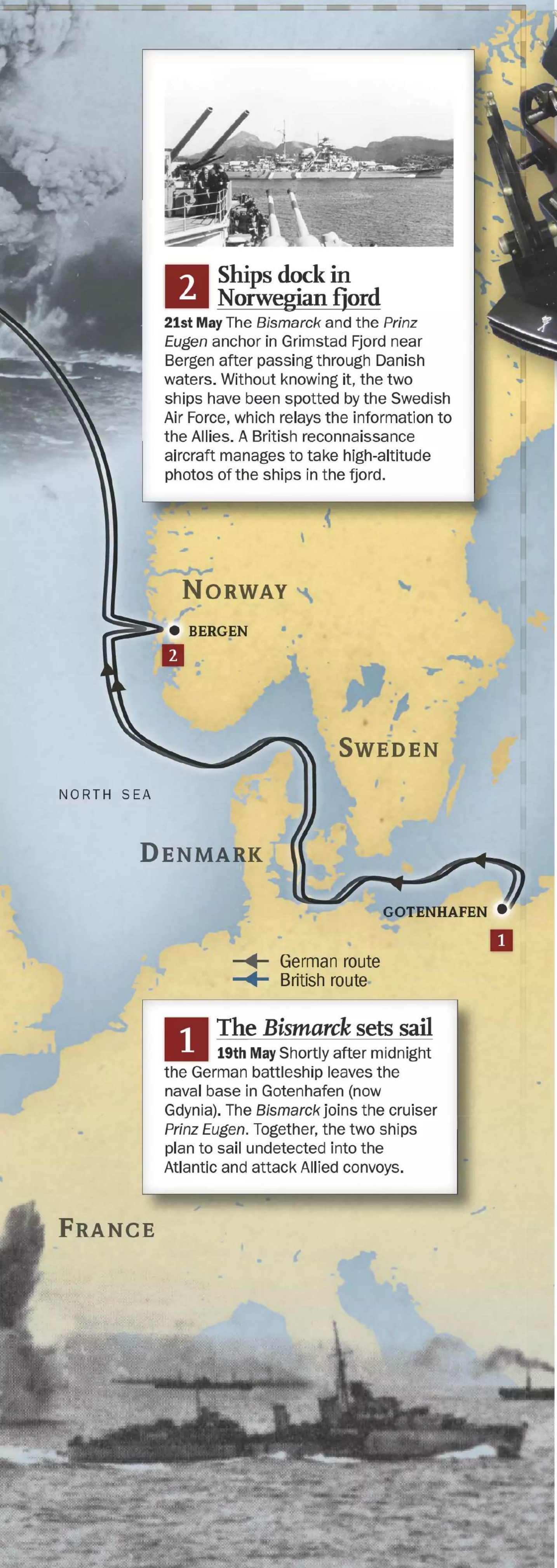
6 American seaplane detects the *Bismarck*

26th May A US pilot spots the *Bismarck*, but most British ships are too far away to attack. The only hope of slowing the *Bismarck* comes from the aircraft carrier the *Ark Royal* to the south.

7 British battleships deliver killer blow

27th May Aircraft from the *Ark Royal* damage the *Bismarck's* rudder. The ship can no longer manoeuvre and is forced to sail in circles – easy prey for the *King George V* and the *Rodney*.

GREENLAND
DENMARK STRAIT
Bismarck
Prinz Eugen
3
Norfolk
Suffolk
ICELAND
4
Hood
Prince of Wales
FAROE ISLANDS
SCAPA FLOW
5
Repulse
Victorious
King George V
SCOTLAND
Rodney
6
ATLANTIC OCEAN
7
Bismarck
BREST
Prinz Eugen
Ark Royal
Sheffield



2

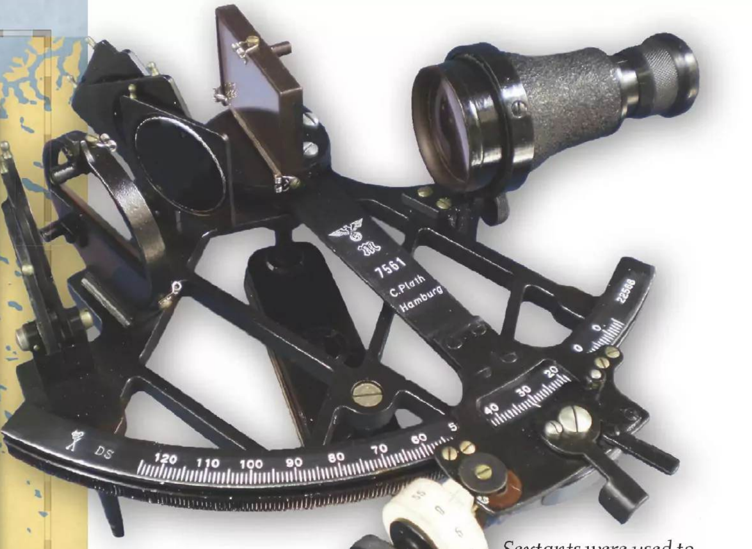
Ships dock in Norwegian fjord

21st May The *Bismarck* and the *Prinz Eugen* anchor in Grimstad Fjord near Bergen after passing through Danish waters. Without knowing it, the two ships have been spotted by the Swedish Air Force, which relays the information to the Allies. A British reconnaissance aircraft manages to take high-altitude photos of the ships in the fjord.

1

The *Bismarck* sets sail

19th May Shortly after midnight the German battleship leaves the naval base in Gotenhafen (now Gdynia). The *Bismarck* joins the cruiser *Prinz Eugen*. Together, the two ships plan to sail undetected into the Atlantic and attack Allied convoys.



Sextants were used to navigate in both the British and German navies.

another on the back. What a ship they had! They'd almost forgotten that the battle was not yet over. The *Bismarck* could now tackle the battleship *Prince of Wales*, which *Prinz Eugen* had been shelling throughout. But before long the admiral gave orders to cease firing, much to the crew's disappointment. The *Prince of Wales* was allowed to sail away wounded. Only three seamen out of *Hood's* 1,418-man crew survived. The loss of the national symbol was a shock to the British.

Churchill's orders came quickly and were brusque and uncompromising: "I don't care how you do it, you must sink the *Bismarck*." Anything that could sail and fire was sent in: four battleships, two aircraft carriers, two battle cruisers, three heavy cruisers, 10 light cruisers and 21 destroyers.

The *Bismarck* had already been hit three times, however. One of the shells had bounced off, but another had pierced the ship's bow and left a half-metre-wide exit hole. The third shell had punched a hole amidships, and the *Bismarck* was now leaving a trail of oil behind her. 2,000 tonnes of seawater had flooded in causing the ship to list slightly to starboard and her bow was lower in the water. The holes had to be plugged with hammocks to prevent more water entering.

PILOTS' DEATH-DEFYING ATTACK

On 24th May, after an inconsequential, early-evening skirmish with a new pursuer, the *Prince of Wales*, it was announced aboard the *Bismarck* that an aircraft carrier was nearby, a message that put the anti-aircraft stations on high alert. By this time, the *Bismarck* was alone apart from the three enemy ships that were now trailing it. The *Prinz Eugen* had escaped the British to continue Operation Rheinübung, while the *Bismarck* sailed towards a French dock for repairs.

At 22.30, with the North Atlantic spring evening still as bright as day, the *Bismarck* sounded her air alarm. Müllenheim-Rechberg watched through his director as nine small Swordfish biplane torpedo bombers approached obliquely from the front.

In an instant the *Bismarck* transformed into a fire-breathing steel monster. Anti-aircraft guns thundered endlessly. Occasionally, the 15-cm and 38-cm turrets aimed at the sea's surface, sending up huge plumes of water into the path of the British aircraft, but the pilots continued with suicidal bravery "as if they did not expect ever again to see a carrier", Müllenheim-Rechberg noted. Each came within 400-

500 metres of the *Bismarck* before releasing their payloads. One by one, the torpedoes hit the water. The *Bismarck* sped up to 27 knots and zigzagged hard, making it virtually impossible for the gunners to hit the aircraft.

Then a sharp report sounded above the *Bismarck*'s guns. A torpedo had hit them. Müllenheim-Rechberg checked his instruments, but the engines and rudder were unharmed.

The torpedo had hit midships on the starboard side – where the *Bismarck*'s armour was strongest. The explosion caused no damage, but the concussion slammed an officer into a solid structure, killing him instantly. It was the first death aboard the *Bismarck*. Six others were treated for fractures.

As the Swordfish vanished over the horizon, the news of the death brought home to the crew how alone and vulnerable they really were, and how close the enemy was. They had sunk the *Hood*, but the victory had only spurred the British to bring everything they could to bear against the *Bismarck*.

SEAPLANE REVEALED POSITION

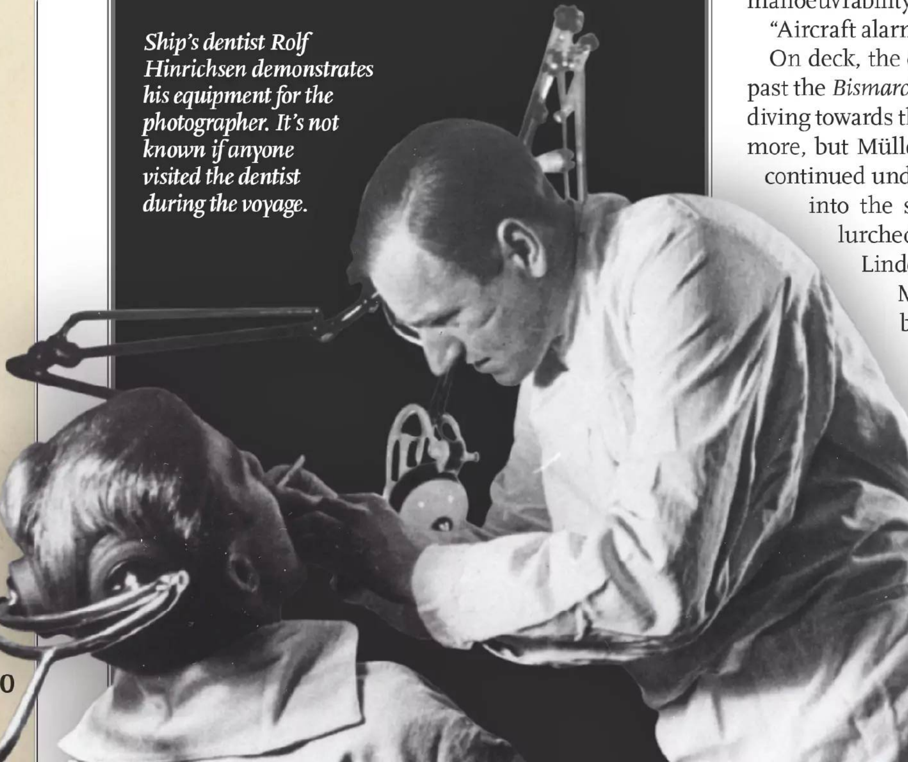
At 11.30 on 26th May, the 2,200 or so men aboard the *Bismarck* had been alone on the Atlantic Ocean for more than 30 hours. As the hours passed, hope that they'd manage to escape their British pursuers grew.

Ship was a floating city

Sailors aboard the *Bismarck* enjoyed a wide range of facilities, including a steam laundry and a modern dental clinic.

When the *Bismarck* set sail on her first – and final – mission, the ship brought enough supplies to feed the crew for several months. The refrigeration area below deck had room for 500 slaughtered pigs and 300 entire cows, and the meat was brought up to the big galleys using an ingenious hoist system. The crew of the Bismarck did not need to suffer with toothache, either, as the ship had its own dental clinic.

Ship's dentist Rolf Hinrichsen demonstrates his equipment for the photographer. It's not known if anyone visited the dentist during the voyage.



Müllenheim-Rechberg was aware, however, that danger was still imminent. They had a chance but only if the *Bismarck* retained her manoeuvrability. Then a Catalina seaplane emerged from between the clouds.

"Aircraft to port! Aircraft alarm!"

The *Bismarck*'s anti-aircraft guns fired at the seaplane, but it escaped, apparently unharmed. Now, the crew was no longer in any doubt: the British knew the *Bismarck*'s position. The lieutenant took solace in the fact that the Catalina had probably come alone and from afar, and that it would be a long time before the British could gather enough battleships to threaten the *Bismarck*'s attempt to dock in France.

SECOND AIR ATTACK WAS DECISIVE

His hope soon faded. Half an hour later a plane with landing gear appeared; an aircraft carrier was nearby. Crew morale sank. The biplane circled just beyond the anti-aircraft guns' range. In the afternoon it was joined by another Catalina, and that evening the British cruiser HMS *Sheffield* arrived.

But the lack of any attack, followed by the subsequent disappearance of her pursuers, gave the Germans fresh hope. Rumours abounded on the ship: the enemy's main strength was more than 100 miles behind – perhaps the aircraft carrier was also too far away to attack? Examining the charts, some of the men calculated that the *Bismarck* might be within protective range of the Luftwaffe by the following morning.

In fact, a mix-up among the British over the German ship's bearing had allowed the *Bismarck* to lose her tail. Many of the British ships who had been following from the start had been forced to abandon the chase due to a lack of fuel, and the chance of ships catching the *Bismarck* who could compete with her huge guns was slim. The only danger for the German vessel came from the south and the approaching aircraft carrier, HMS *Ark Royal*. Her Swordfish planes' torpedoes could slow the *Bismarck* or cripple her manoeuvrability, allowing the British ships to catch up.

"Aircraft alarm!"

On deck, the crew watched as 16 Swordfish biplanes flew past the *Bismarck* at high altitude, then reappeared, this time diving towards the ship. The *Bismarck*'s guns opened up once more, but Müllenheim-Rechberg could see how the pilots continued undaunted, dropping one torpedo after another into the sea around the *Bismarck*. The entire ship lurched violently from side to side while Captain Lindemann manoeuvred to avoid the weapons.

Müllenheim-Rechberg listened for a torpedo blast to pierce the noise of the *Bismarck*'s guns. Two sharp explosions sounded in rapid succession, but they'd hit the forward section where the armour was strong.

Moments later a third blast could be heard. A British pilot had dropped his torpedo directly aft of the *Bismarck* just as the ship was making an evasive turn to port. The torpedo almost instantly struck the *Bismarck* where it was most vulnerable:

A sailor on the Prinz Eugen *signals the* Bismarck *with flags in order to maintain radio silence.*

Bismarck

Length	251 metres
Width	36 metres
Weight	50.955 tonnes
Top speed	31 knots (57 km/h)
Main weapons	8 x 38-cm guns 12 x 15-cm guns
Crew	2,212

SEA MONSTER WAS IMMENSE

When the *Bismarck* set sail on her maiden voyage, the ship was the most formidable in the world: it had strong weaponry, was heavily armoured and extremely fast. Her range was also huge – around 16,000 kilometres, almost half way around the Earth.

HMS Hood

Length	262 metres
Width	32 metres
Weight	48.360 tonnes
Top speed	29 knots (53 km/h)
Main weapons	8 x 38-cm guns 12 x 14-cm guns
Crew	1,418

PROUD SHIP HAD ONE WEAK POINT

The *Hood* was a symbol of the British Empire's naval power during in the interwar period. But she had one weak point: her deck armour was relatively thin. The weight savings afforded her greater speed, but also meant that the ship was vulnerable to shells landing from above.

the rudder. The lieutenant's heart sank. He looked instinctively at the rudder position indicator. It was frozen at "left 12 degrees".

DAMAGE WAS IMPOSSIBLE TO REPAIR

The *Bismarck* fired on the *Sheffield*, which had crept closer during the Germans' battle with the Swordfish, succeeding in scaring her off, but the rudder's position indicator had still not moved: the *Bismarck* had lost her ability to steer. Lindemann fired off orders to attempt to regain control using a combination of the engines and propellers, but to no avail.

Slowly, the *Bismarck* was forced into the wind and into an involuntary semicircle. A repair team tried unsuccessfully to free the rudder mechanism. But it quickly had to give up as the space filled with water.

With the *Bismarck* now sailing away from her former course towards France, the British realised that the ship must have been seriously damaged. They seized the opportunity. The *King George V* and the *Rodney* sailed north-west of the *Bismarck*, planning to approach under cover of darkness and attack at dawn.

During the night of 27th May a strong north-west wind blew up into a storm, and the waves rose to 15 metres high. The crew's last-ditch attempt to repair the damaged rudder was abandoned around midnight. The wind and the high waves relentlessly pushed the ship off course.

Rain lashed down over the *Bismarck* as a group of British destroyers fired torpedoes towards the stricken vessel, which returned fire with volleys from its guns – but neither side's salvoes were effective. Meanwhile, Admiral Lütjens sent a message to fleet command. He knew that the battle was lost, but surrender was not an option. Parts of the communication between the *Bismarck* and naval command were read out over the speakers on board:

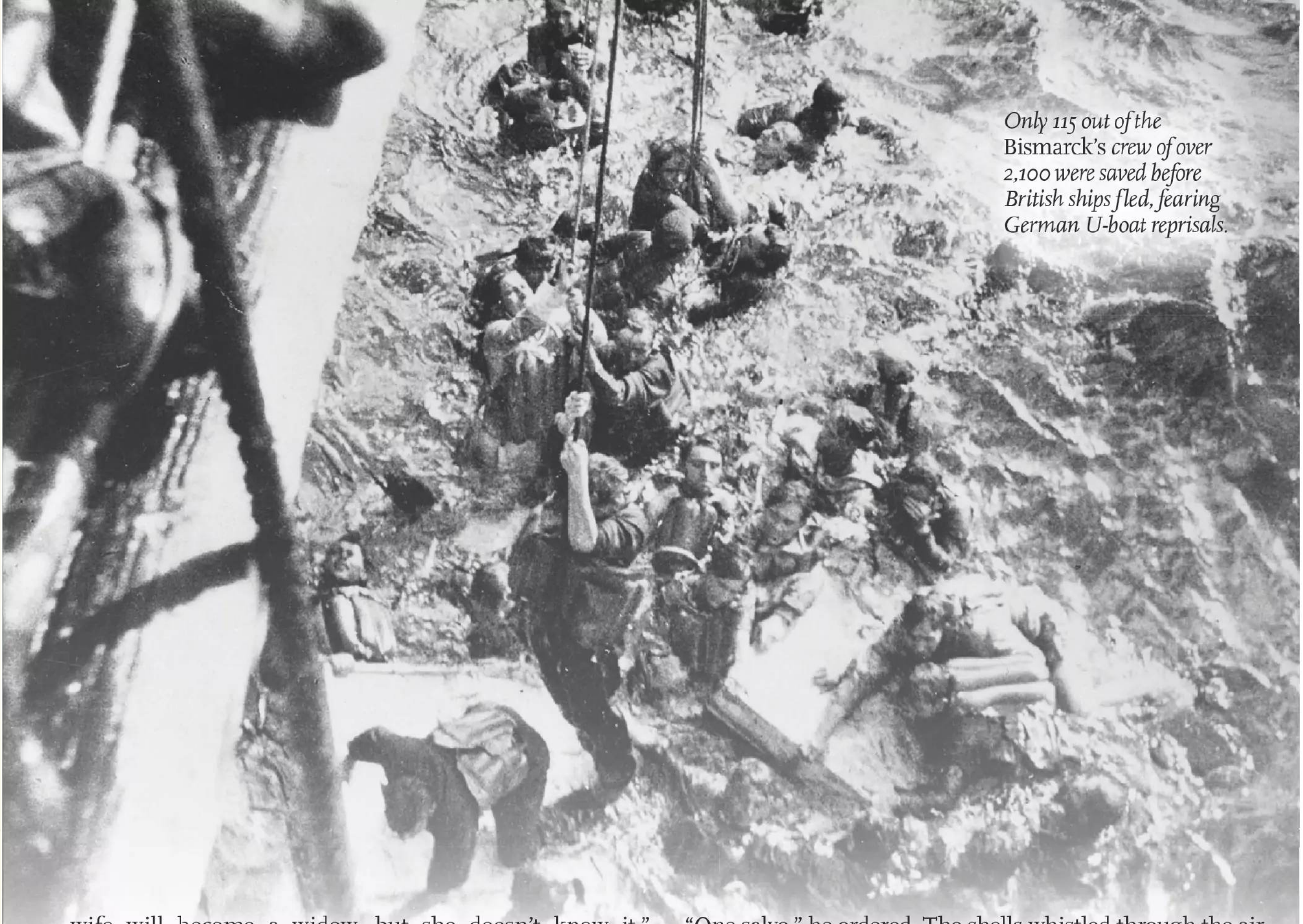
> **John Tovey,** an English admiral, praised the *Bismarck* and her crew for having managed to attack in almost impossible circumstances and for fighting to the last.

"Fleet Commander to the Führer of the German Reich, Adolf Hitler: We will fight to the last in belief in you, my Führer, and in unshakeable confidence in Germany's victory".

The reply came soon after: "Adolf Hitler to crew of the *Bismarck*: All of Germany is with you. What can be done, will be done. Your performance of duty will strengthen our people in the struggle for its destiny".

For the crew, it sounded like a death sentence rather than a rallying cry. The *Bismarck* was promised assistance from German tugs and bombers, but Müllenheim-Rechberg knew they couldn't arrive in time. When the ship's commander gave the crew permission to take what they wanted from the ship's stores, he knew that Lütjens and Lindemann had decided that the situation was hopeless.

Time passed without a renewed British attack. As the clock ticked around to 08.00, Müllenheim-Rechberg decided to make a last round of the ship. In the wardroom, men sat morosely around the table. One spoke: "Today my



Only 115 out of the Bismarck's crew of over 2,100 were saved before British ships fled, fearing German U-boat reprisals.

wife will become a widow, but she doesn't know it." Müllenheim-Rechberg left the sorry group to visit the bridge. Exhausted men were all around, and in the middle of it all was Captain Lindemann – wearing an open life jacket. The lieutenant saluted, but the usually jovial captain did not even glance back. He seemed petrified.

On the way back to his post, Müllenheim-Rechberg met Admiral Lütjens and saluted. Lütjens returned the greeting, but without conviction. The lieutenant looked at his watch. It was after 08.30 – where were the British?

THE EXECUTIONERS CAME AT DAWN

Suddenly, the alarm bells rang. Müllenheim-Rechberg ran to the aft gunner's station and picked up the control phone.

"Two battleships, port bow", a voice said. He turned to his rangefinder and saw the unmistakable silhouettes of the *King George V* and the *Rodney*, about 24 kilometres away and heading straight for the *Bismarck*. They looked as impassive as a pair of executioners.

At 08.47 the first salvoes were fired from the British ships, and minutes later the *Bismarck* returned fire. But the British were firing rapidly and shells rained down on the German vessel.

After just 20 minutes the *Bismarck*'s two forward turrets were shot to pieces, but the aft pair remained intact. Müllenheim-Rechberg was ordered to take charge of them. The defence was now in his hands. He scanned the horizon for targets with his rangefinder. Around 11 kilometres away, he saw the *King George V*.

"The target is the battleship at 250 [degrees]", he reported to the calculation room deep beneath the turrets. "Ready," was the answer.

"One salvo," he ordered. The shells whistled through the air and struck the right side of the British battleship. Another salvo further to the left and then another. The shells struck the water directly in front of the *King George V*. The direction had been found, only the distance was missing.

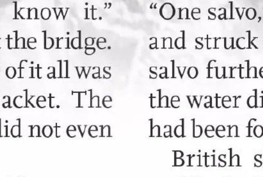
British shells still rained down on the *Bismarck*, and suddenly Müllenheim-Rechberg's rangefinder shook so violently that the eyepiece slapped him hard in the face. When he recovered, he tried to look into the rangefinder once more, but there was nothing to see. Just as he was about to find his range, the rangefinder had broken. A British shell had ripped through all the instruments in the aft fire control centre, reducing it to a useless steel box. The lieutenant had no choice but to let the men in the turrets fire as best they could. Outside there was chaos.

LAYERS OF DEAD MEN

The constant British shelling had transformed the *Bismarck* into a blazing wreck of death and mutilation. The lifeboats had been shot to pieces long ago. In despair, some of the crew jumped into the water, while others ran around the deck in a hopeless panic. Here and there, the ship's doctors dashed between the wounded sailors, trying to help.

Deep down in the starboard engine room Petty Officer Wilhelm Generotzky had noticed the reduction in the thunder from the *Bismarck*'s guns, but was pleased that none of the enemy's shells had penetrated the armoured deck above him.

"It's over!" shouted the second mate, the colour gone from his face. The ship was listing increasingly towards port, and soon the



The Bismarck *was named after the chancellor who united Germany in 1871.*

surviving officers gave the order: "Scuttle ship." It was time for the crew to abandon the vessel.

Generotzky climbed from the depths through a shaft as one of the last in a group of 40 men. When he reached the ladder's top rung and could place his hands on deck, they landed in pools of blood. On the shattered deck were piles of dead and dying men, three or four layers deep.

In the officers' mess, men had smashed the necks off schnapps bottles and were swallowing the contents, even as blood ran from the cuts made by the glass's sharp edges. Some had fallen to the floor, senseless.

The British continued to lob shells onto the ship, while a dismayed Generotzky tried to find shelter. At 10.21, the sound of murderous shell fire finally stopped.

Müllenheim-Rechberg waited a little longer before he ordered the men who had sought refuge in his fire control centre to leave the ship. He was the last to leave his post.

Outside he met a gruesome sight: white smoke had started to emerge from the fires below decks, shrouding most of the bow. The tower mast and foremast protruded above the smoke and men stumbled aimlessly around. The chimney had a hole in it, and the entire deck was covered with twisted metal. Where once there had been guns and instruments, there was now nothing. The lieutenant struggled over metal fragments and holes in the deck to the starboard side of the stern.

For a long time, he and a small group of men waited for rescue boats to arrive – but the sea was empty. Finally, there was nothing for it but to jump before the *Bismarck* sank and sucked them into the depths alongside her.

Around Generotzky things became more and more desperate as the *Bismarck* went down: some officers shot themselves, while others jumped into the water.

"She's sinking!" someone shouted, and at that moment the deck almost disappeared under Generotzky's feet. The entire starboard side rose into the air, and then he jumped into the water, too. When he finally emerged from the depths 100 metres from the sinking giant, he saw the whole ship lying keel up. Then, with a gurgling sound, she disappeared under the waves.

CAPTAIN STAYED WITH HIS SHIP

Only 115 of the *Bismarck*'s crew survived. Among them were Müllenheim-Rechberg and Generotzky, both of whom were picked up by British ships. First Gunnery Officer Adalbert Schneider died a few minutes into the fighting. Later, Müllenheim-Rechberg wrote the book *Battleship Bismarck: A Survivor's Story* about his experience.

The cruiser *Prinz Eugen* continued her journey, but had to abandon the mission because of engine trouble after a few days. The ship managed to reach the safety of Brest in German-occupied France on 1st June 1941.

Admiral Lütjens was killed by a shell on the *Bismarck*'s bridge, while Captain Lindemann went down with his ship. His men saw him standing in the bow to the last. When the *Bismarck* keeled over, he climbed onto the hull and saluted until he was swallowed by the depths.

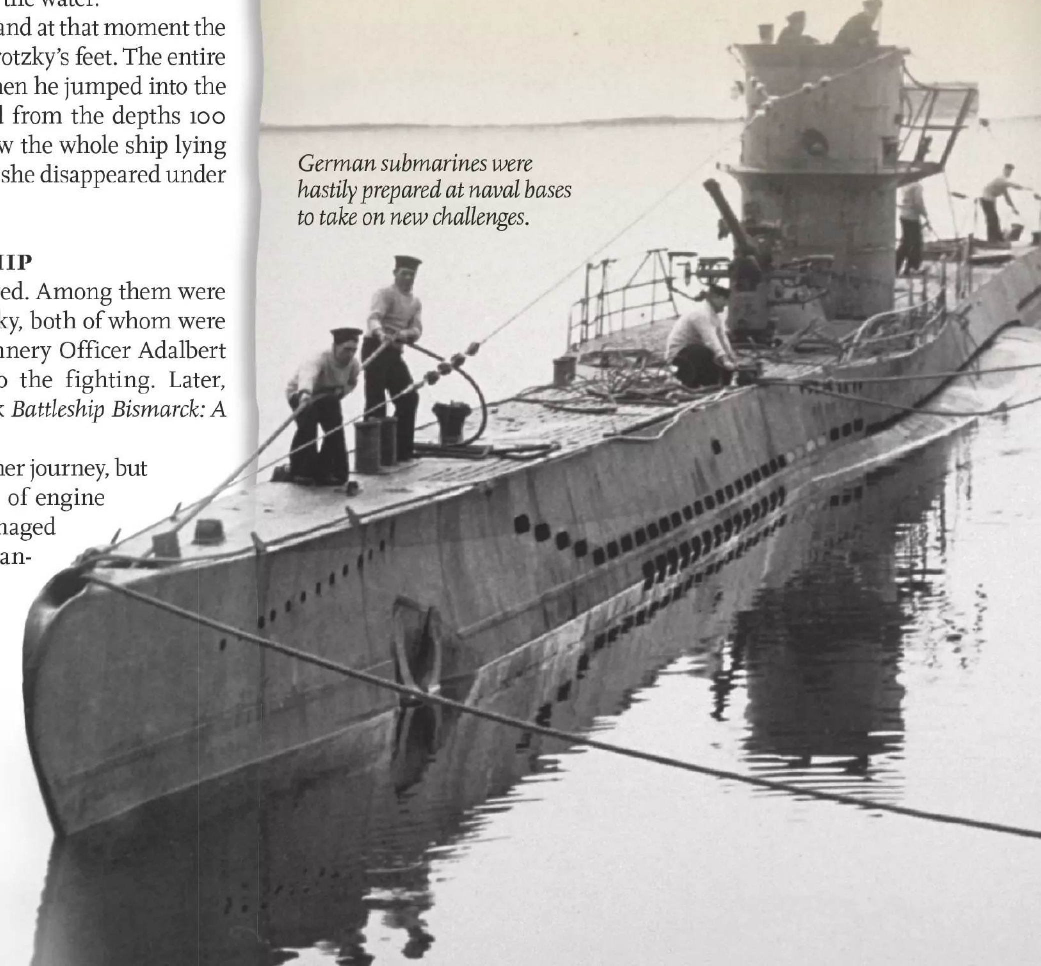
Germans went underwater

After the *Bismarck's* demise, the Germans had no chance of dominating conventional naval warfare. Instead, the Nazis turned to U-boats.

As an island nation and long-time naval power, Britain was determined to control the seas – it was the only way she could guard against a German invasion and protect vital convoys of supplies and soldiers, especially from the US and Canada.

After the sinking of the *Bismarck*, it was difficult for the Germans and their allies to threaten British vessels with surface attacks. Admittedly, the *Prinz Eugen* was still operational, and the Germans had a few other large ships, including the *Bismarck's* sister ship, the battleship *Tirpitz*. But thanks to persistent attacks on naval bases – in particular bombing raids by RAF planes and torpedo attacks by British submarines – German vessels spent a lot of time in dock undergoing repairs.

German naval leaders were aware of the situation and chose to focus their efforts on a large U-boat fleet. Shortly after the outbreak of war, the Germans notched up a series of successful submarine expeditions, and as the production of U-boats took off, vessels were gathered into so-called 'wolf packs', which attacked Allied shipping across the Atlantic.



German submarines were hastily prepared at naval bases to take on new challenges.

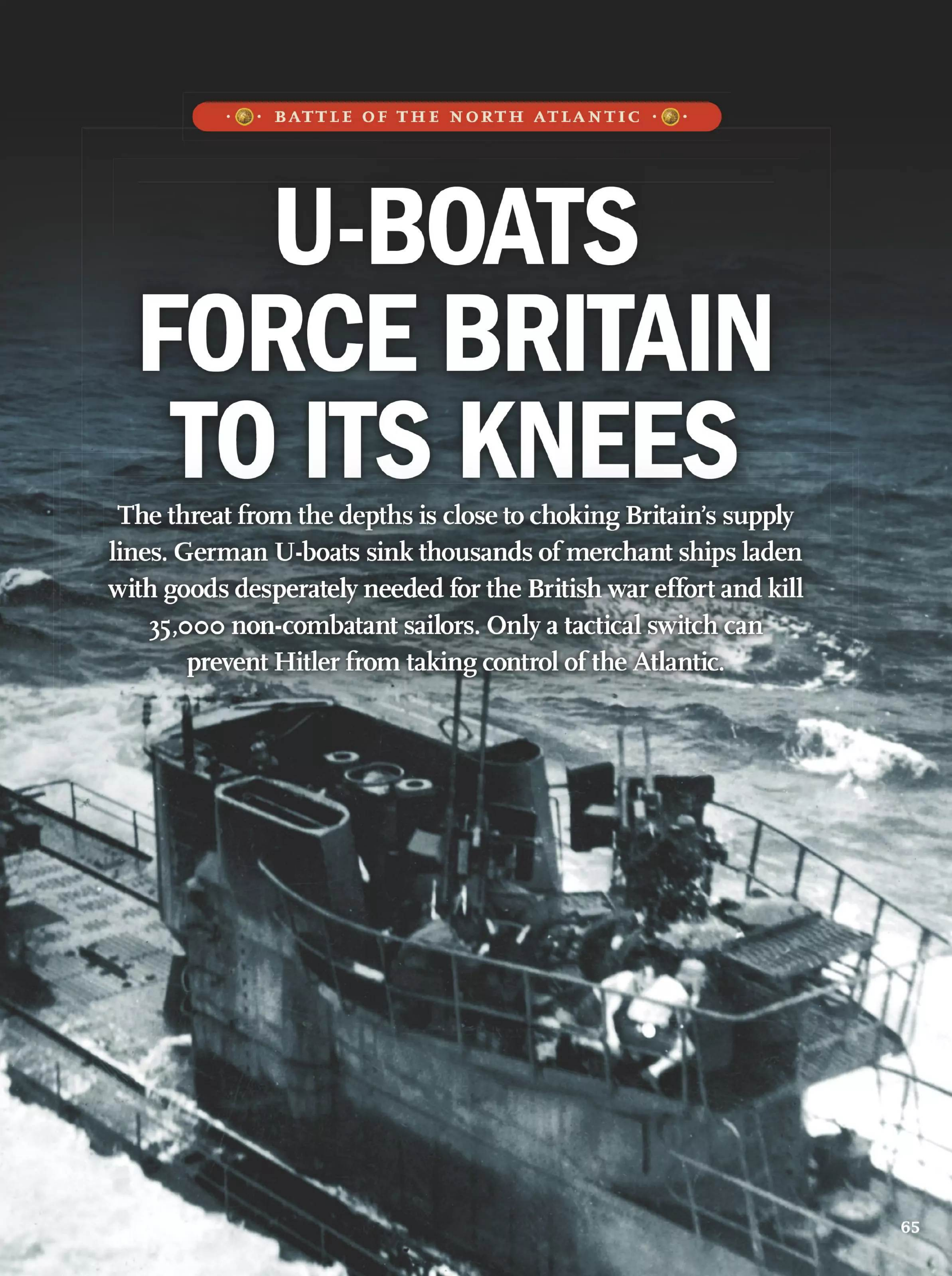
The submarines operated mostly on the surface and usually dived only during attacks.

1941

13TH NOVEMBER

U-BOATS FORCE BRITAIN TO ITS KNEES

The threat from the depths is close to choking Britain's supply lines. German U-boats sink thousands of merchant ships laden with goods desperately needed for the British war effort and kill 35,000 non-combatant sailors. Only a tactical switch can prevent Hitler from taking control of the Atlantic.



North Atlantic 1941

THE STAGE IS SET

NORTH ATLANTIC

After the Battle of Britain, Hitler abandons the idea of invading Britain. Instead, the small island nation must be starved into submission. If the Nazis can prevent vital US and Canadian convoys from reaching British shores, Churchill will be forced to capitulate. It's time for the Führer to send his U-boats into the Atlantic.

ON THE AFTERNOON OF 13TH NOVEMBER 1941 THE aircraft carrier *Ark Royal* had carried her cargo to Malta and was now on her way back to Gibraltar.

As she travelled through hostile territory, there was a high risk of attack from German aircraft and U-boats, but the *Ark Royal* had already withstood several attacks.

At 15.40, the sonar operator on the British destroyer the *Legion* heard an unusual sound. He assumed it was the propellers of one of the six other surrounding destroyers. But a minute later, a blast was heard from *Ark Royal's* starboard side. The explosion caused the ship to list violently to one side. The power went out, oil spewed, and smoke threatened to choke the crew. Captain Loben Maund moved urgently from the deck to the bridge to discover that a torpedo had hit the aircraft carrier between its fuel tank and ammunition store. The captain knew that it was time to abandon ship and requested the destroyer *Legion* to come alongside to take the *Ark Royal's* 1,500 crew on board. At the same time, the other escort ships went on the hunt for the U-boat.

On board the *U-81*, the sound of the blast had roused the crew. Anyone who wasn't on duty ran down to the sub's bow. The heavier it was, the faster it went down.

The men could hear a terrifying sound: "ping... ping... ping". British sonar was reflecting off the submarine's hull. Immediately afterwards, a battleship's propeller could be heard overhead. The *U-81* sailed in a zigzag, alternately rising and diving to escape the sonar and the 130 depth charges that rained down on it. The strategy worked and *U-81* was able to sneak away to continue its pursuit of British merchant ships and warships. In total, the U-boat would send 26 Allied vessels to the seabed in the Mediterranean and Atlantic Ocean before an American depth charge finally hit finished its career in April 1944.

The success of the *U-81* and many other German submarines came as no surprise to Admiral Karl Dönitz, commander of the German U-boat fleet. Even before the

1891-1980

NAME **KARL DÖNITZ**

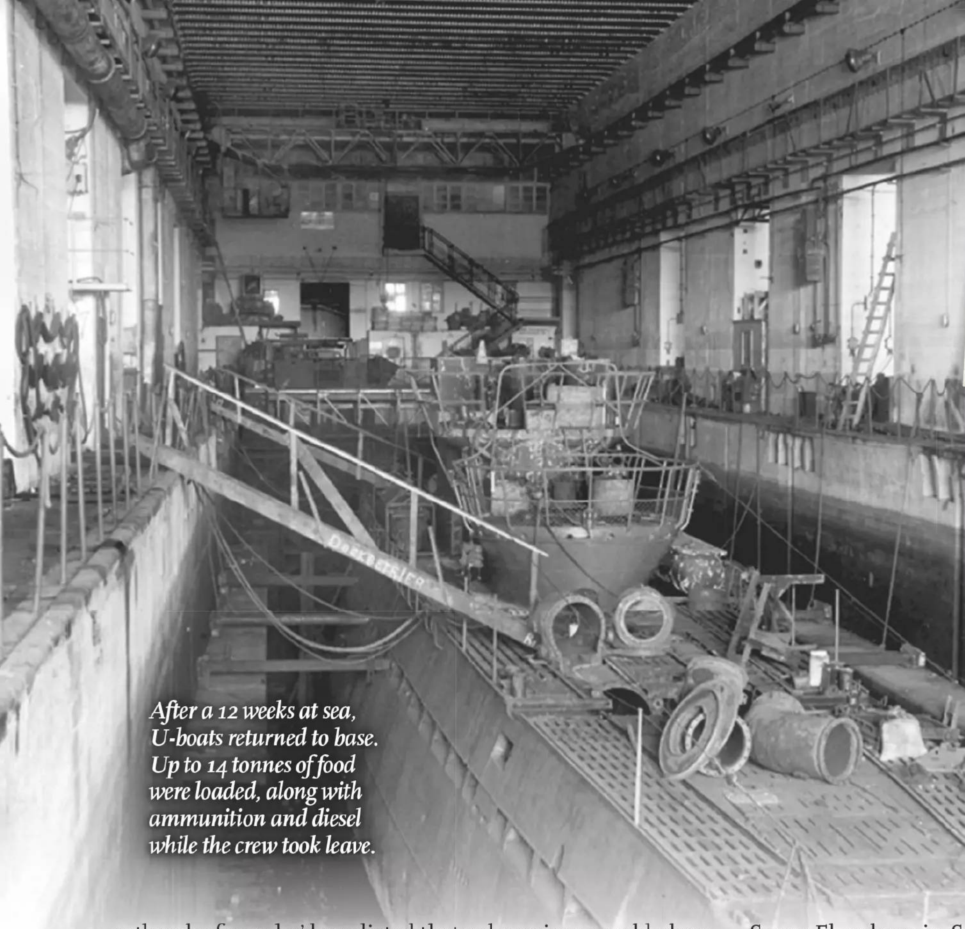
TITLE COMMANDER-IN-CHIEF OF THE GERMAN NAVY

Admiral won the respect of his men

Karl Dönitz, who commanded the German submarine fleet, made a habit of enquiring into his men's private lives and sending telegrams to all fathers in the U-boat service when their wives gave birth – even if the men were at sea and far from Germany at the time. His concern made him popular among his men, who called him the Lion. Dönitz acknowledged them in turn by calling them grey wolves after their grey boats and leather uniforms.

Dönitz started on the *Breslau* in 1913. Three years later, he was promoted to first lieutenant and switched to the U-boat service. Throughout the years, he climbed the ranks, and by 1939 had the rank Commander of the Submarines. In 1943, Dönitz assumed command of the entire Kriegsmarine. In his political testament, Hitler appointed the admiral as his successor, and he led Germany in its last days. At the Nuremberg Trials, Dönitz was sentenced to 10 years in prison – a sentence he never accepted. He died in 1980.

- **Served aboard U-boats during World War I.**
- **Commanded the German U-boat fleet from 1935.**


After a 12 weeks at sea, U-boats returned to base. Up to 14 tonnes of food were loaded, along with ammunition and diesel while the crew took leave.

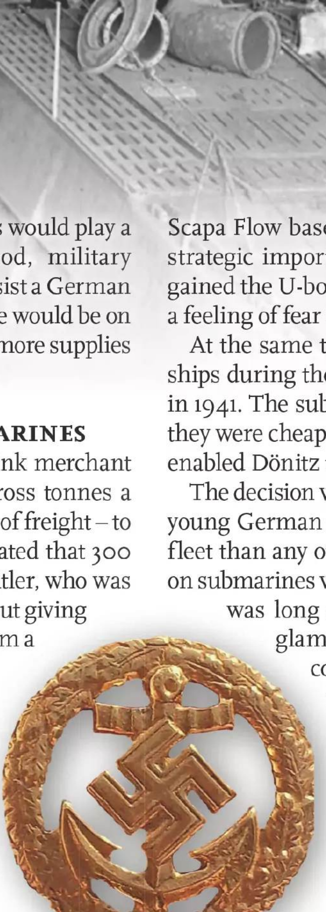
The U-boat base in Brest, France was reinforced with five-metre thick concrete that repeated Allied shelling failed to penetrate.

outbreak of war, he'd predicted that submarines would play a crucial role. Britain was dependent on food, military equipment and fuel from the United States to resist a German invasion. Once Britain had been isolated, the race would be on to starve the British into submission by sinking more supplies than they could replace.

ADMIRAL BEGGED HITLER FOR SUBMARINES

Dönitz believed the German fleet needed to sink merchant ships with a total weight of about 700,000 gross tonnes a month – equivalent to two million cubic metres of freight – to force the British to submit. The admiral estimated that 300 subs would be needed to fulfil that task. But Hitler, who was prone to seasickness, was initially lukewarm about giving submarines such a prominent role. "On land I am a hero. At sea I am a coward," he said.

But despite his misgivings, the Battle of the Atlantic began in 1939. First Lord of the Admiralty Winston Churchill began a blockade of Germany on 26th September. Hitler retaliated with his U-boat fleet.


This gold-plated medal was one of the German Kriegsmarine's honours.

For Hitler the battle had been joined too soon – only 57 of his subs were combat-ready, far fewer than Dönitz wanted. The majority were also smaller vessels that could only reach targets in the North Sea before needing to return home. Consequently, Dönitz asked Hitler for permission to modernise the fleet with the new type VII submarine, which had an operating range of more than 10,000 kilometres, allowing it to operate in the Atlantic for longer periods.

Hitler had begun to rethink his opinion about naval warfare since 14th October, 1939 when the German sub *U-47* sank the British battleship HMS *Royal Oak*, which was anchored in the Scapa Flow base in Scotland. The sinking was not of major strategic importance, but it was a propaganda victory that gained the U-boats' respect among Germans while instilling a feeling of fear into the British.

At the same time, the Germans lost several large surface ships during the early part of the war, not least the *Bismarck* in 1941. The subs' proven efficiency, along with the fact that they were cheaper and faster to produce than surface vessels, enabled Dönitz to convince Hitler to invest more in U-boats.

The decision was popular in military circles, and soon more young German men were requesting to serve in the U-boat fleet than any other military force. Not least because service on submarines was considered the most honourable. Training was long and the prestige high, but there was little glamour to life at sea: during their tours, the men could look forward to 12 weeks in a crowded windowless cabin with 50 smelly and stressed men. At its widest point, the vessel measured five metres, but most of the space was occupied by engines, batteries, torpedoes, ammunition and supplies.

EVERYTHING WAS ALWAYS WET

Being on board a submarine was not for landlubbers; most of the time, the vessels sailed on the surface, where the waves buffeted the sailors back and forth. Four men kept a lookout for air attacks from the command tower, and when the door to the tower was open during the North Atlantic's frequent storms, sea water entered the cabin. Even though the water was pumped away, everything was constantly wet.

The long voyages also meant that the greatest threat to morale and unity was not the enemy's warships, but

GERMAN U-BOATS

Two models served distinct roles

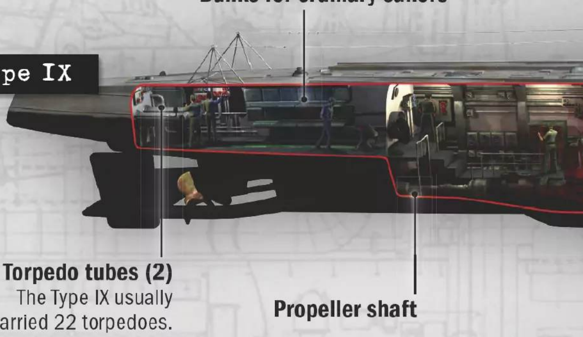
German engineers couldn't build a single U-boat that was both big enough to sail long distances and yet small enough to dive quickly. The solution was to make two.

Shipyards received their first orders to produce submarines in March 1935, two months before Hitler officially broke the 1919 Treaty of Versailles.

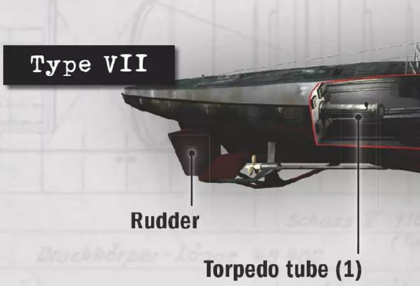
Engineers had a difficult task. First, they had to construct a vessel that could dive quickly to carry both crew and equipment to safety. Originally, fleet command also requested a long-range boat. But while small boats could dive quickly, only large boats could carry enough fuel, supplies and ammo for long voyages.

It was impossible to reconcile the differences and build a single sub with all these features. The solution was to create two models.

Needless to say, the crew's desire for reasonable space and comfort had no influence on either design.



The Type IX usually carried 22 torpedoes. In some cases the sub was also used as a minesweeper.



IX (model IXC)

Range, surface	11,000 nautical miles
Range, submerged	63 nautical miles
Length	76.8 metres
Draft	4.7 metres
Weight	1,232 tonnes
Speed, surface	18.3 knots
Speed, submerged	7.3 knots
Electric engines	2 x 500 hp
Diesel engines	2 x 2,200 hp
Crew	55

BIG BROTHER HAD A LONG RANGE

With a range of 11,000 miles (20,400 km), the big brother of the German submarine fleet could operate across the Atlantic and even to the Indian Ocean. The IX model was valued for its spaciousness but its slow dive rate made serving on it dangerous. 194 were launched.

VII (model VIIC)

Range, surface	6,500 nautical miles
Range, submerged	80 nautical miles
Length	67.1 metres
Draft	4.8 metres
Weight	865 tonnes
Speed, surface	17 knots
Speed, submerged	7.6 knots
Electric engines	2 x 375 hp
Diesel engines	2 x 1,400 hp
Crew	48

LITTLE BROTHER DIVED QUICKLY

The smaller type VII dived swiftly and could usually escape Allied warships. On the other hand, the tight spaces were a nightmare for the men. The VII model was the backbone of the German submarine fleet with over 700 vessels deployed during the war.

Ships were safest in square convoys

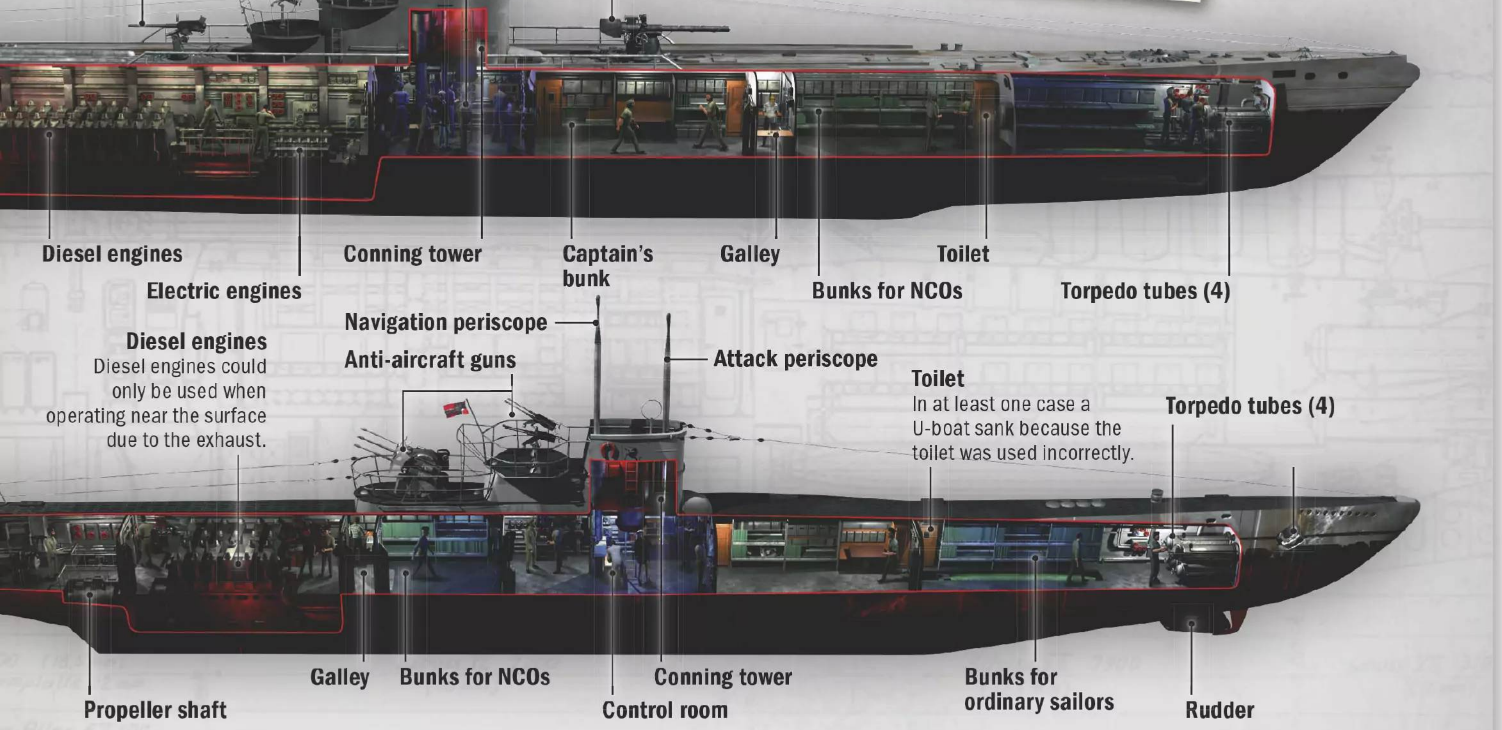
Traditional convoys that travelled in long lines were quickly abandoned. Instead, the Allies sailed in a square formation so the accompanying warships could protect the cargo ships more easily. At the same time, the ships with the most valuable cargo sailed in the middle, where there was less risk of a torpedo hitting them.

German U-boat
Allied freighter
Allied escort

boredom. Time passed slowly while the captain searched the ocean for prey. Even reading was often impossible because the batteries needed saving. These were needed to operate the electric motor when the diesel engines were shut down during diving. Fights sometimes broke out among frustrated crew members in the lulls.

In the first year of the war, German submarines had to sail around the north of Scotland to reach the convoys in the Atlantic. But after the fall of Norway and France in June 1940, U-boat bases were moved to the Norwegian and French Atlantic coasts. Precious sailing time was saved, and the Germans seemed to have a real chance of isolating the British and winning the Battle of the Atlantic.

Before the war, Britain imported 59 million tonnes of food and raw materials per year plus all the oil it needed. Thanks to U-boat attacks, that number had fallen to just 12 million

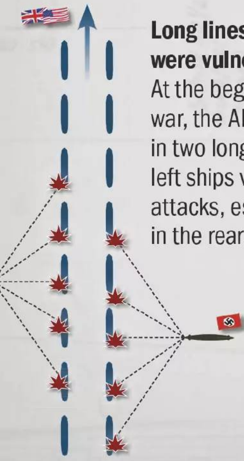

Attack periscope
Navigation periscope
Anti-aircraft gun
Radar
Deck gun
Diesel engines
Electric engines
Conning tower
Captain's bunk
Galley
Bunks for NCOs
Toilet
Torpedo tubes (4)
Navigation periscope
Anti-aircraft guns
Attack periscope
Torpedo tubes (4)
Propeller shaft
Galley
Bunks for NCOs
Control room
Conning tower
Bunks for ordinary sailors
Rudder

Control room
Early models had a third periscope in the control room, which disappeared in Type IXC.

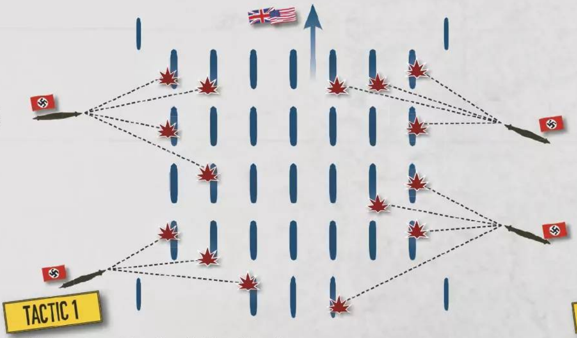
Diesel engines
Diesel engines could only be used when operating near the surface due to the exhaust.

Toilet
In at least one case a U-boat sank because the toilet was used incorrectly.

The space on board was so cramped that the crew had to take turns sleeping. The U-boat's torpedoes were also stored in the same room.

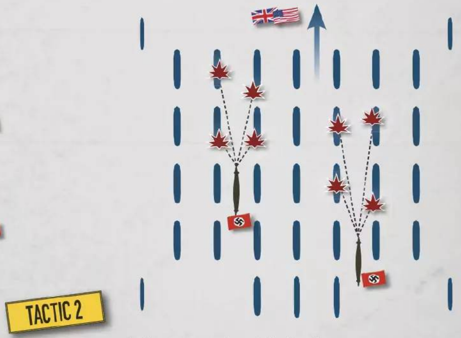


Long lines were vulnerable
At the beginning of the war, the Allies often sailed in two long lines. But this left ships vulnerable to attacks, especially those in the rear.



TACTIC 1

U-boats attacked the flanks
The square convoys were attacked from their sides. U-boats fired torpedoes from a long distance, hoping some would hit their marks.



TACTIC 2

Brave captains sneaked in between
The boldest U-boat commanders went between the ships under cover of darkness, then fired torpedoes from close range before diving.

tonnes by the end of 1940. The British also felt under siege, and there was a fear that the war would be lost on the home front where people were living on starvation rations: "Nobody really understood how close we were to actually losing the war due to lack of food," a business economist revealed later.

Wolf packs attacked in the dark

By 1941, submarine attacks had become an effective offensive tactic for the Germans, who carried charts of the Atlantic divided into 10 x 10-kilometre quadrants. Each quadrant was labelled with two letters and four digits, so that radio operators could send coded messages revealing where they had sniffed out prey, after which the U-boats met in so-called wolf packs.

The submarines positioned themselves in a line across the convoy's route, ready to attack the following night. Up to 30 submarines would surface simultaneously to launch a coordinated attack. Germans used battery-powered, silent torpedoes that typically hit the side of the target ship. But it was best if the torpedo exploded just below its hull. The explosion forced the water away leaving a vacuum, so that the hull expanded. When the water returned, the keel would break. The Germans often encountered problems with failing igniters and defective balance chambers early in the war. Later, engineers developed torpedoes to home in on the noise from a ship's propellers; otherwise, they continued through the water without exploding until they hit something.

A brave captain was able to navigate between the lines of convoy ships at night and torpedo key targets, which were usually located in the middle of the formation. After an attack, captains sometimes hid beneath a merchant ship, where their U-boat was almost impossible to detect. Once the panic was over, they could steal quietly away.

Hitler threatened Allies with torpedoes

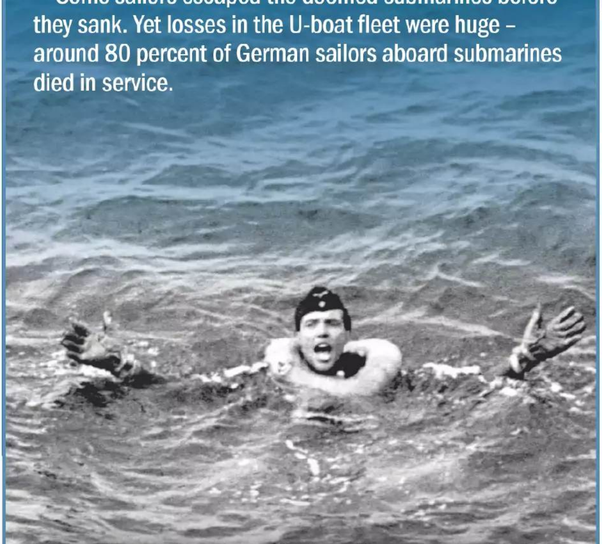
These audacious raids were well on the way to forcing Britain to its knees. Prime Minister Winston Churchill later wrote that, "The only thing that ever really frightened me during the war was the U-boat peril." From June to October 1940, the grey wolves sank hundreds of Allied ships, and the submarine crews referred to the period as *Die Glückliche Zeit* (Happy Times). Hitler had become a complete convert to U-boat warfare by this point, stating that, "Whoever believes that he can help England should know one thing in any event: any ship, with or without escort, that comes in front of our torpedo tubes will be torpedoed!"

Eight out of 10 died at sea

The crew of a wrecked submarine was doomed. When the boat sank, it almost always became a coffin.

All sailors aboard German U-boats were taught how to use a 'tauchretter', a life jacket with breathing apparatus that could, in theory, save them from drowning. But in practice, the vest was useless, because it was very difficult to get out of a U-boat once it was lying at the bottom of the sea. And if they did manage it, sailors would die due to decompression sickness (the bends).

Some sailors escaped the doomed submarines before they sank. Yet losses in the U-boat fleet were huge – around 80 percent of German sailors aboard submarines died in service.

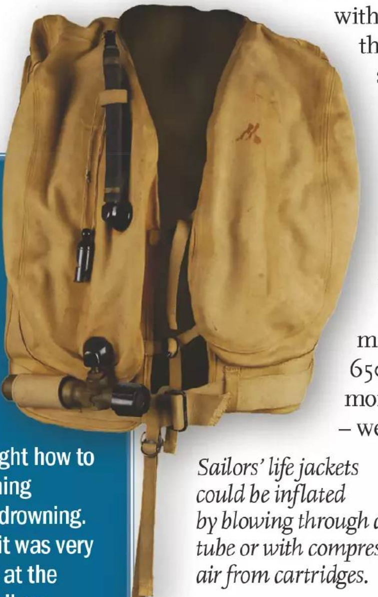


The sailors on the U-175, which sunk on 17th April 1943, were statistically lucky: only 13 out of 41 died.

The Germans repeated the threat when the country declared war on the US in December 1941. Now Dönitz could – with great pleasure – initiate his attack on the Americans with Operation Paukenschlag (drum beat). With the help of their dairy cows – supply submarines that could resupply U-boats with food and fuel – the wolf packs could reach the US East Coast. Here, American vessels sailed alone without the protection of convoys. This, and the lack of blackout orders, made their ships easy prey for the U-boats.

At the same time, the Germans broke Allied codes in the summer of 1942. Thanks to the intercepted information, U-boat command knew many of the convoys' routes, as well as which ones were most vulnerable due to a lack of escort ships.

During an average month in 1942, merchant ships with a total weight of 650,000 gross tonnage – equivalent to more than 1.8 million cubic metres of goods – were sunk. The number was very close to Dönitz's target of how much was required to cripple Britain. And thanks to efficient U-boat production, by the beginning of 1943, the fleet could boast no fewer than 400 operational submarines, of which around half were in the front line.



Sailors' life jackets could be inflated by blowing through a tube or with compressed air from cartridges.

Still, it wasn't enough. The missions were many, the Atlantic was huge, and the Allies had begun to get wise to German tactics. At the same time, a number of new technological inventions and tactical ideas began to make an impact in the way the naval battle was fought.

Depth charges could shred a sub's hull

The Allies thought it safest to cross the Atlantic in convoys, which typically consisted of 20-60 merchant ships. Each convoy was formed into a square, to occupy minimum space. This made them harder to spot, yet also easier for the escort ships to defend them. U-boats lay low in the water, and a convoy could be missed from the command tower from as little as 30 kilometres away. On the other hand, the Germans had radio equipment that could intercept communications between the British ships. And as the vessels drew closer, the Germans could hear the noise from their propellers and engines using a specialised underwater microphone known as a hydrophone.

However, the British also had some new tricks up their sleeves. Early in the war, the escort ships searched for subs using the ASDIC sonar system. This relied on an acoustic

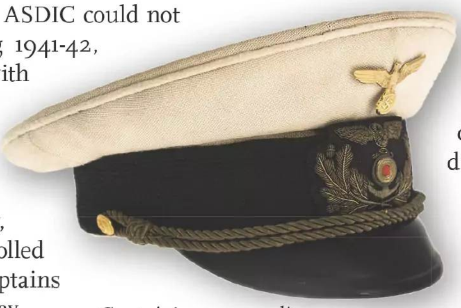
Crew members kept a lookout for merchant ships through the periscope while sailing near the surface. The U-boat only dived once a ship was discovered and they were ready to attack. Often other submarines were summoned, so the U-boats could hunt as a pack.

technique where sound waves emitted from a dome beneath the ship would bounce back if they hit any underwater objects. The echo allowed the system to calculate the distance, direction and depth of the object. But ASDIC could not detect ships on the surface. During 1941-42, however, ships were also equipped with radar that could reveal surface objects via microwave emissions.

Once the escort ships had located a sub, depth charges were dropped. The Allies were handicapped, however, because depth charges could only be rolled off the rear deck. German U-boat captains simply had to manoeuvre out of their way.

Normally, a depth charge had to detonate at four to six metres from a U-boat to breach its hull. Detonations from 7-15 metres would damage a sub, while explosions at a greater distance primarily had a psychological effect.

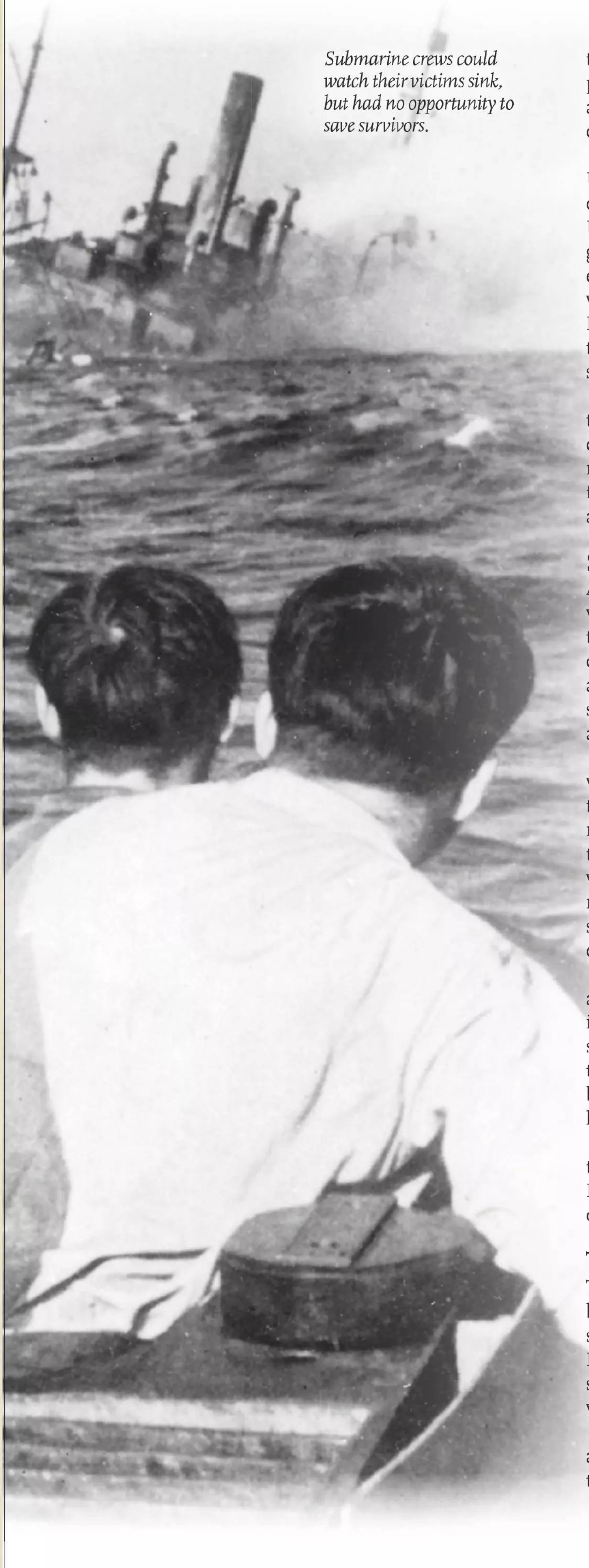
As a rule, it wasn't a single well-placed depth charge that would sink a sub, but an intense bombardment involving many charges. Escort ships also tried to drop depth charges in a diamond shape around a submarine to maximise the chance of damage. The weapon's main disadvantage was that the charges were primed to explode at a specific depth. Plus, if the attack failed, the blasts created so much disturbance in the water that it was difficult to restore sonar contact.



Captain's cap – an elite group consisting of just three percent of German U-boats sank 30 percent of all Allied ships.

But from the end of 1942, the British installed a newly developed mortar – the Hedgehog – on their escort ships. These mortars fired 24 depth charges from the ship's bow, which only detonated if they hit something. And if one charge was triggered, then the rest exploded, which increased the weapon's effectiveness. Thanks to the Hedgehog, it became harder for subs to escape undamaged after an attack.

At the same time, the threat from the air grew. At the start of the war, subs could settle in the middle of



Submarine crews could watch their victims sink, but had no opportunity to save survivors.

the Atlantic, out of reach of enemy planes. But as the war progressed, long-range aircraft with bases in North America and the British Isles were capable of providing air cover for the convoys along most of their route.

At first, even with radar, pilots found it tricky to locate the U-boats before they could dive, thanks to the great expanse of ocean. The Germans had introduced a snorkel system, so that U-boats could remain immersed and avoid detection. But gradually, the Allies developed advanced radar systems, enabling pilots to spot a small snorkel poking up out of the water. At the same time, the planes were equipped with the Leigh Light (L/L), which automatically aligned with the radar to bathe a submarine in light in the middle of the night. The submarines had gone from hunters to prey.

By the end of the war, the wolf packs were also suffering at the hands of aircraft carriers, which provided permanent air cover, supplemented by merchant ships fitted with launch ramps for fighters. The subs weren't armoured, so bombs from an Allied plane could prove fatal. In total, about half of all U-boats sunk received the killer blow from aircraft.

SUBMARINES WERE CHASED FOR HOURS

As Allied superiority grew, the convoys were also reinforced with groups of escort vessels that patrolled the waters around the convoy, so the merchant vessels and their close support could escape if attacked. As the groups weren't associated with any particular convoy, they could continue chasing a submarine for hours if necessary while the convoy continued across the Atlantic.

Ultimately, however, the deciding factor was production: who could build the most vessels in the shortest time. When the United States entered the war at the end of 1941, the mighty American production facilities became a factor that the Germans could not match in the long term. The record was set when an American shipyard managed to build a merchant ship on assembly lines in four days. In addition, ship engines became more powerful, so the ships could outrun the U-boats.

At the end of 1942 and the beginning of 1943, the Allies' accelerated production helped turn the Battle of the Atlantic in their favour in just a few months. In May 1943, the Allies sank 41 submarines. The period was dubbed "Black May" by the Germans. Dönitz realised that the North Atlantic had now become too dangerous for his submarines, and on 24th May, he ordered them away from the North Atlantic convoy route.

Instead, the admiral gradually deployed many of his vessels to remote hunting fields in the Caribbean, India and the Far East, where they docked at Japanese bases. But the submarines only enjoyed limited success in those distant waters.

TERROR TACTICS HADN'T WORKED

The French U-boat bases were also exposed to heavy bombings from the air, and eventually the German submarines were displaced to bases in the Baltic and Norway. But here too, they were chased by the RAF. Many subs were sunk in the straits between Denmark, Sweden and Norway while attempting to head out into the Atlantic.

The belief among those in the submarine fleet that this was a tactic worth pursuing dropped dramatically. But it wasn't the case with Hitler. In 1945, he sent new super type XXI and

XXIII U-boats into the war. But the battle had long been lost. There were no longer sufficient numbers of submarines for the previously successful tactic of hunting in packs to be used. Now the subs were lone wolves who scoured the sea and attacked singly, putting them at greater risk of being spotted and bombed by the Allies.

Some grey wolves still slipped into the Atlantic and hunted all the way to the US East Coast. It was here that one of the last U-boats was sunk by the US coastguard. It happened after Grand Admiral Dönitz had called off the fight on 4th May 1945 with the words:

“Six years of U-boat war lie behind us. You have fought like lions. A crushing material superiority has forced us into a narrow area. A continuation of our fight from the remaining basis is no longer possible... Lay down your arms after a heroic battle without equal. We remember in deep respect our fallen comrades, who have sealed with their death their loyalty to the Führer and Fatherland... Long live Germany!”

7 x 50-mm Carl Zeiss binoculars were standard issue on German subs.

The lone sub off the US coast never received the radio signal, and the whole crew drowned. The sailors were the last to die in the war.

A total of 28,000 German sailors died during the Battle of the Atlantic. Allied losses were also severe. Over 5,000 vessels ended at the bottom of the ocean, most of which were sunk by U-boats. The total tonnage destroyed by the Germans was over 14 million, and around 35,000 sailors on Allied vessels lost their lives.

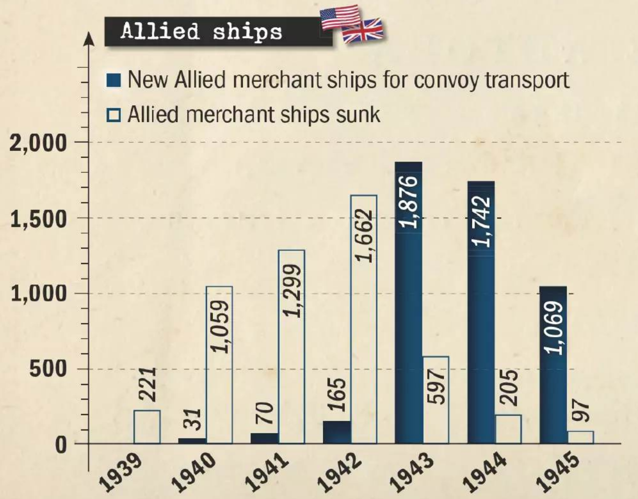
PERSPECTIVE

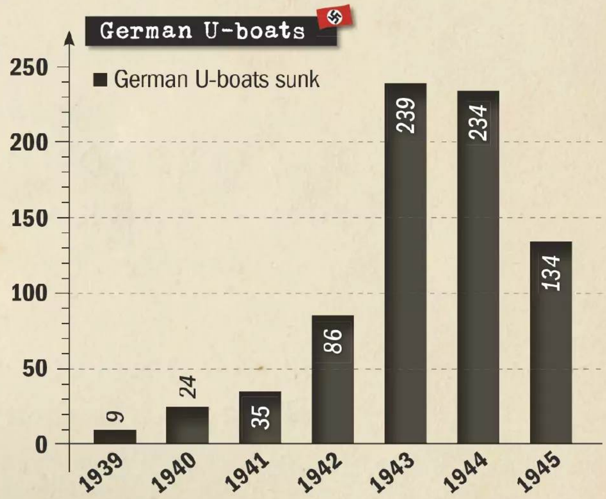
U-boats could not keep pace

Once the US put its industry on a war footing, it produced so many new merchant vessels that the German subs simply could not sink enough vessels to make a difference.

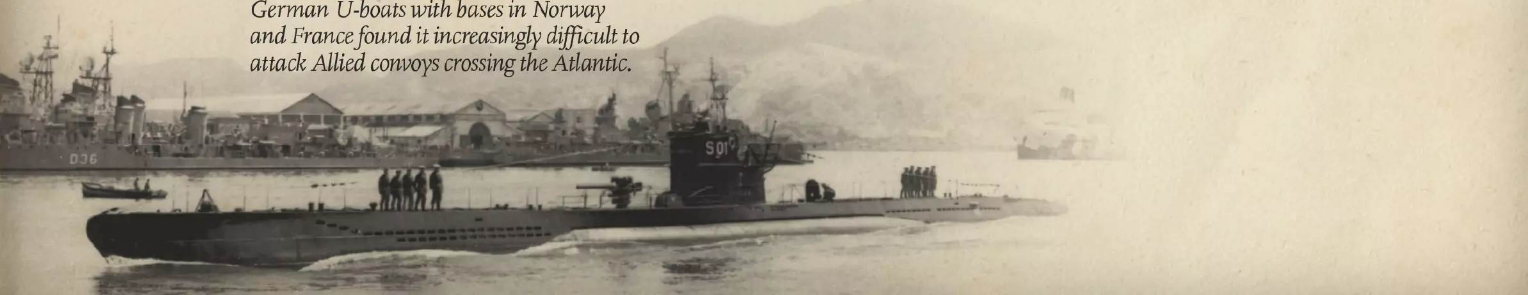
In the first year of the war, the British only managed to put a few German submarines out of action. But in the spring of 1943, development of new technologies and defensive techniques, including depth charges, had advanced so far that the Allies sank 41 subs in May alone. The massive losses continued throughout the war. At the same time, US production of new merchant ships peaked in 1943, by which point they were making more than the Germans' subs could sink. Thus, the Allies could send convoys to Russia and especially Britain packed with supplies and troops.

Soldiers from the US and Canada, together with the evacuated forces from Dunkirk, provided the nucleus of the army that landed in Normandy in June 1944 to begin the liberation of Europe.





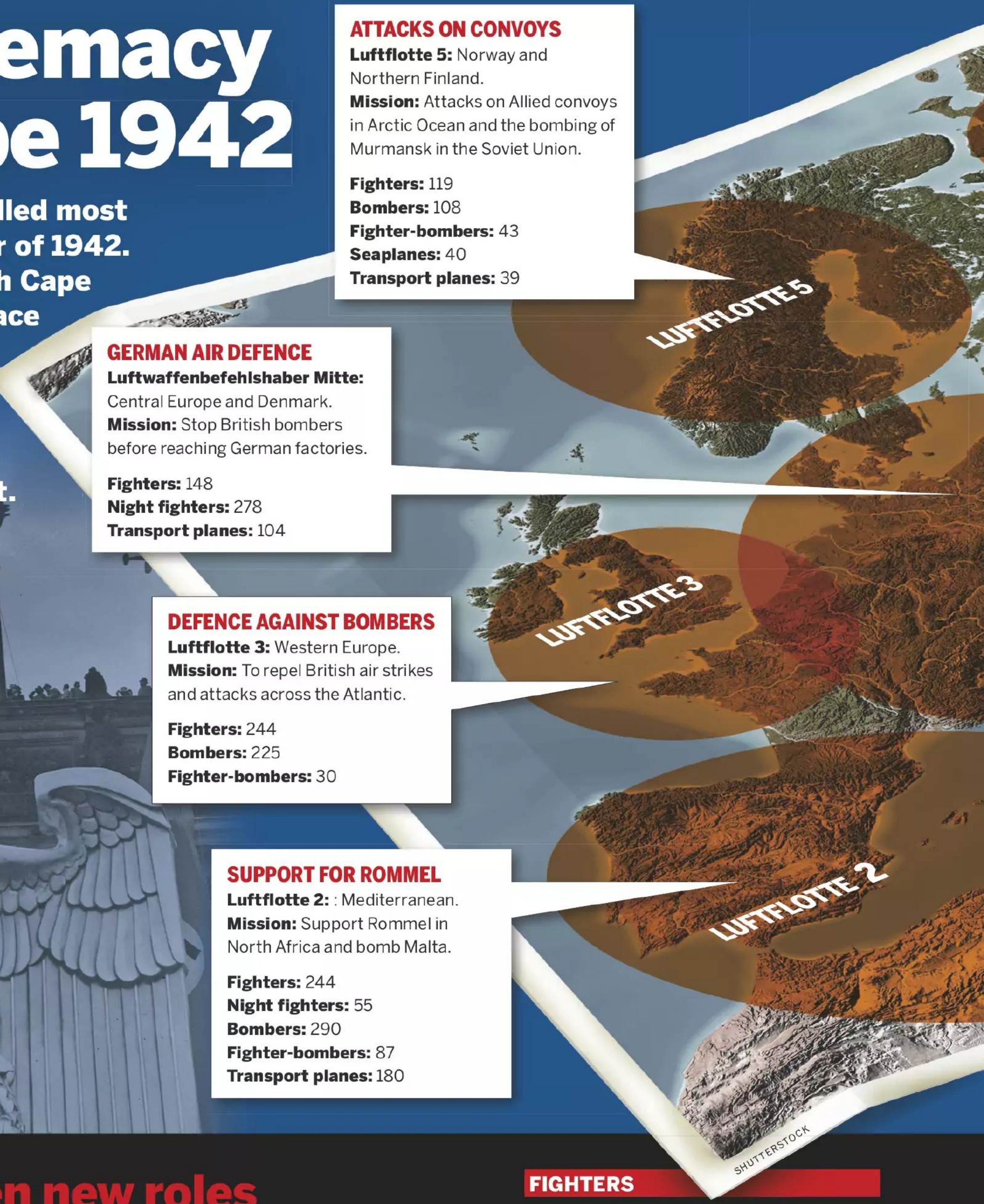
German U-boats with bases in Norway and France found it increasingly difficult to attack Allied convoys crossing the Atlantic.



Air supremacy in Europe 1942

Hitler's Germany controlled most of Europe in the summer of 1942. From the Norway's North Cape to the Sahara, the airspace was divided into sections where the Luftwaffe constantly watched for enemy troops, ships and aircraft.

RIJKSMUSEUM



SHUTTERSTOCK

ATTACKS ON CONVOYS

Luftflotte 5: Norway and Northern Finland.
Mission: Attacks on Allied convoys in Arctic Ocean and the bombing of Murmansk in the Soviet Union.

Fighters: 119
Bombers: 108
Fighter-bombers: 43
Seaplanes: 40
Transport planes: 39

GERMAN AIR DEFENCE

Luftwaffenbefehlshaber Mitte: Central Europe and Denmark.
Mission: Stop British bombers before reaching German factories.

Fighters: 148
Night fighters: 278
Transport planes: 104

DEFENCE AGAINST BOMBERS

Luftflotte 3: Western Europe.
Mission: To repel British air strikes and attacks across the Atlantic.

Fighters: 244
Bombers: 225
Fighter-bombers: 30

SUPPORT FOR ROMMEL

Luftflotte 2: : Mediterranean.
Mission: Support Rommel in North Africa and bomb Malta.

Fighters: 244
Night fighters: 55
Bombers: 290
Fighter-bombers: 87
Transport planes: 180

Old planes given new roles

The Luftwaffe constantly developed new aircraft, but rarely phased out old ones. For example, the Junkers Ju 52 was used as a passenger plane in 1930, as a bomber from 1935 and later as a transport plane.

HISTORIE ARCHIVE

Junkers Ju 52 'Tante Ju' in one of its many roles: transport plane.

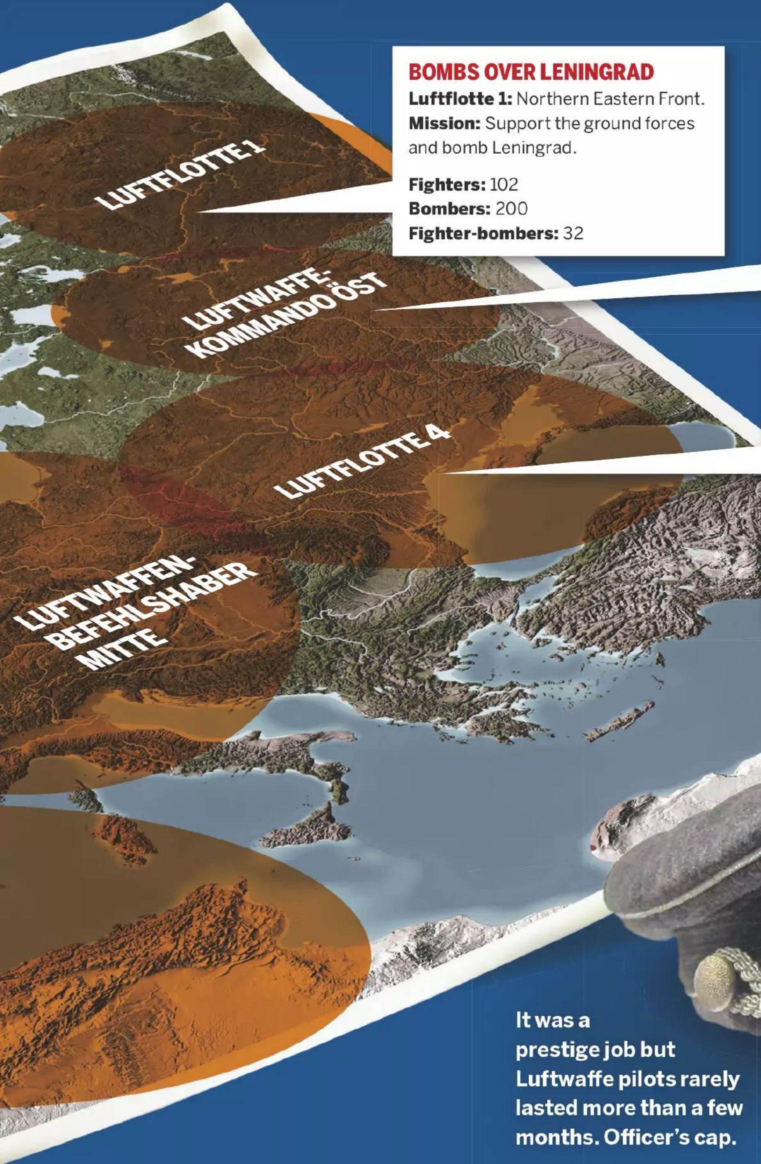
FIGHTERS

Name	In service	Number
Heinkel He 51	1935	700
Arado Ar 68	1936	500
Messerschmitt Bf 109	1937	35,000
Focke-Wulf Fw 190	1941	14,000
Messerschmitt Me 262	1944	1,400

Below: The Bf 109 was one of the few aircraft produced throughout the war.

HISTORIE ARCHIVE

Messerschmitt Bf 109



BOMBS OVER LENINGRAD

Luftflotte 1: Northern Eastern Front.
Mission: Support the ground forces and bomb Leningrad.

Fighters: 102
Bombers: 200
Fighter-bombers: 32

REINFORCEMENT OF THE EASTERN FRONT

Luftwaffekommando Öst: Eastern Front.
Mission: New force. To fill the gap between Luftflottes 1 and 4.

Fighters: 246
Bombers: 179
Transport planes: 104

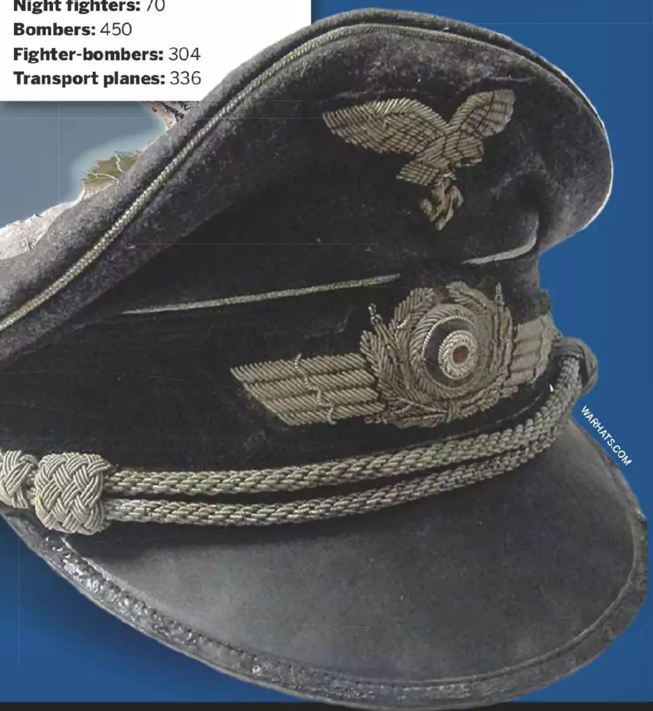
HELP FOR STALINGRAD

Luftflotte 4: South Eastern Front.
Mission: Support the ground forces' offensive towards the Caucasus and Stalingrad.

Fighters: 303
Night fighters: 70
Bombers: 450
Fighter-bombers: 304
Transport planes: 336

BUNDESARCHIV, BILD 146-1984-112-13/CONRAD/CC-BY-SA 3.0

Ernst Udet, head of development for the Luftwaffe, wanted to use more dive bombers.


WARHATS.COM

It was a prestige job but Luftwaffe pilots rarely lasted more than a few months. Officer's cap.

NIGHT FIGHTERS

Name	In service	Number
Messerschmitt Bf 110	1937	6,200
Messerschmitt Me 410	1943	1,200
Heinkel He 219 Uhu	1943	300

Below: The Bf 110 was developed for long-range fighting but had no chance against Britain's Spitfire, so was given radar and hunted bombers at night.

Messerschmitt Bf 110

HISTORIE ARCHIVE

FIGHTER-BOMBERS

Name	In service	Number
Henschel Hs 123	1936	250
Junkers Ju 87 Stuka	1936	6,000
Messerschmitt Bf 109 Jabo	1940	350
Henschel Hs 129	1942	850
Focke-Wulf 190 Jabo	1942	6,000

Below: The Hs 123 was the Luftwaffe's precision bomber until Stuka took over.

Henschel Hs 123

HISTORIE ARCHIVE

BOMBERS

Name	In service	Number
Dornier Do 11	1932	370
Heinkel He 111	1935	7,300
Dornier Do 17	1937	2,100
Junkers Ju 88	1939	15,200
Heinkel He 177 Greif	1942	1,200

Below: Ju 88 was supposed to be a blitz bomber that could escape the enemy.

Junkers Ju 88

BUNDESARCHIV, BILD 101I-417-1766-03A/ ELLERBROCK/CC-BY-SA 3.0

Engineers work on new types of ship in a yard in Britain. There were many ideas, but most had to be scrapped.

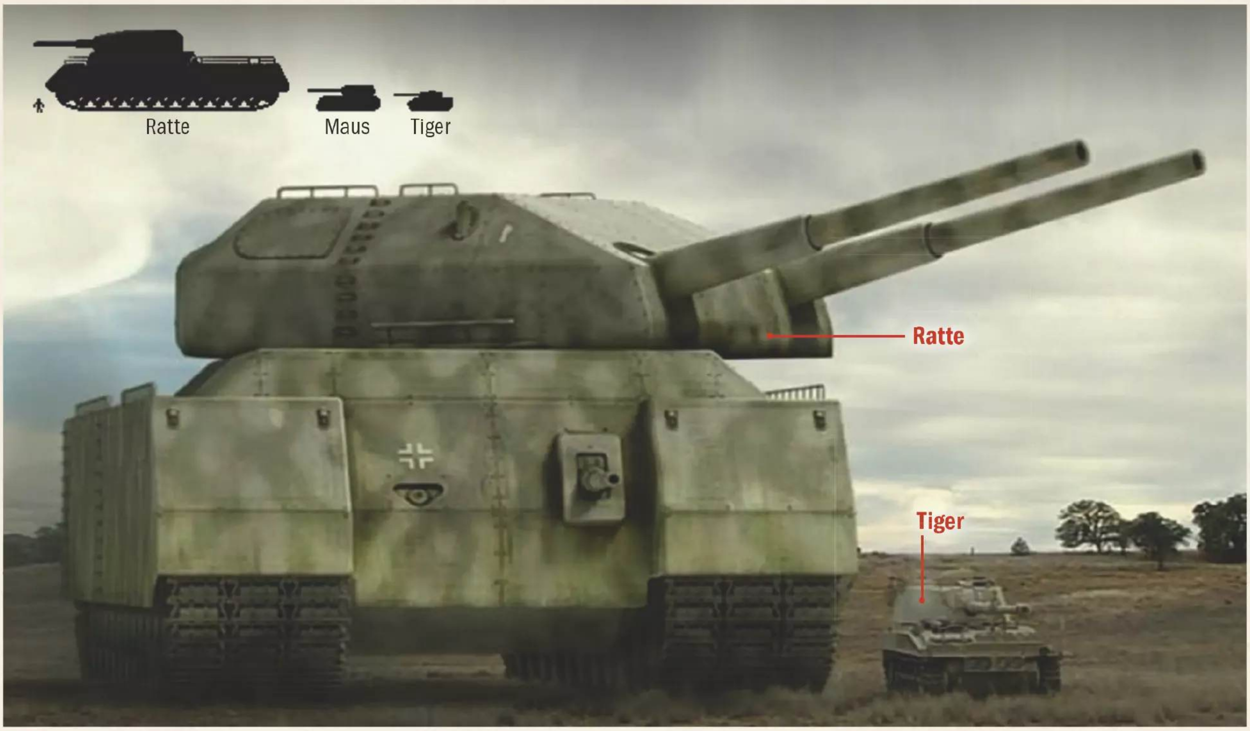
1942

WILD PROJECTS

FANTASY WEAPONS LEAVE THE DRAWING BOARD

As the fight on the battlefield waves back and forth, frazzled brains on both sides try to come up new weapons that can win the war. Some projects come to fruition, but many more creative weapons prove to be more dangerous to the user than to the enemy.

Nazi Germany had plans for an atomic bomb, *but the project was never given top priority. The technique chosen by the German physicist team demanded heavy water from Norway, and production was repeatedly sabotaged. Nevertheless, it was possible to build a test reactor in Haigerloch in south-west Germany. But before the work started, the Allies arrived in 1945 and dismantled the reactor (see picture).*



The super-heavy tank Ratte (rat) was so large *other German tanks like Tiger and Maus looked like toys next to it. Ratte would have weighed 1,000 tonnes and boasted a crew of at least 20 men. Hitler was excited about the giant tank, but when it proved too heavy to cross bridges while its size made it an easy target for air attacks, the project was shelved by Minister of Armaments Albert Speer in 1943.*

ON LAND

Giant projects were stillborn

Opposing land forces were often evenly matched during battles, so engineers were given the task of developing new versions of conventional tanks and powerful superweapons to tip the balance.

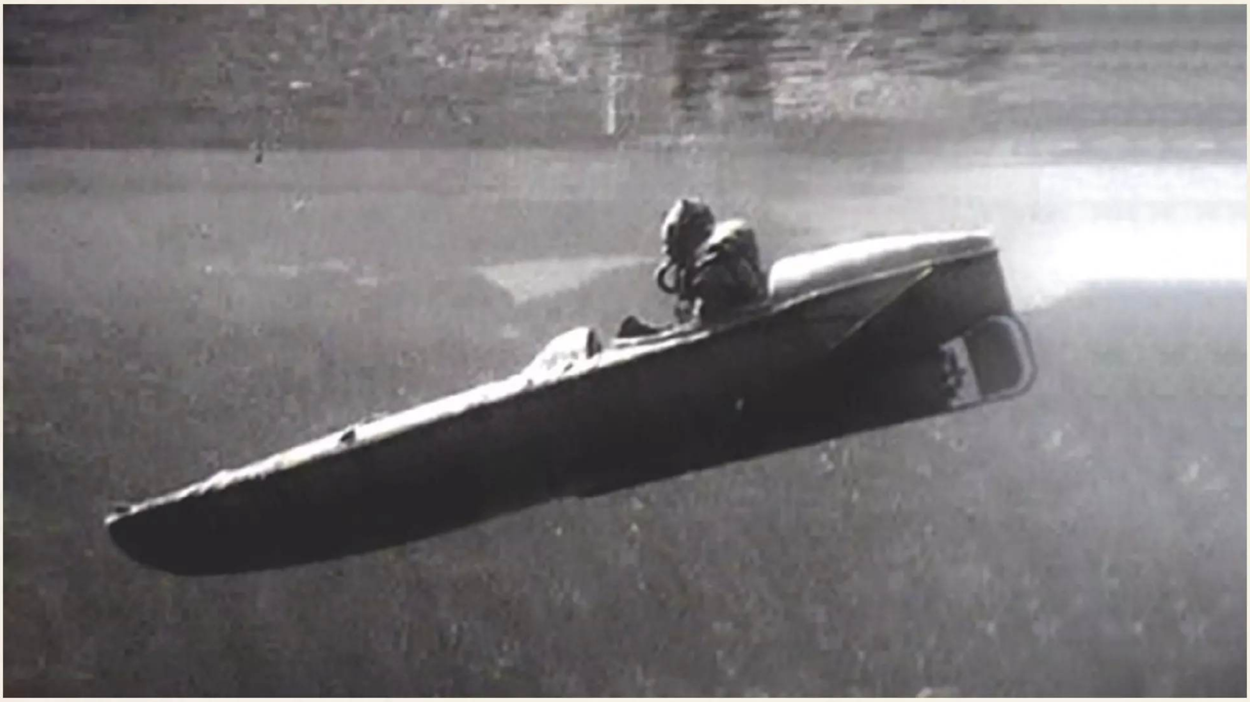
In Germany, Edward Grotte from the Krupp Group proposed a monstrous tank, while Bob Semple in New Zealand went in the opposite direction to design a mini-tank that could be cobbled together by handy amateurs. The tank also had a secondary role as a minesweeper.

However, all efforts on the battlefield would have been immaterial if the German dream of creating a Nazi atomic bomb had become reality.

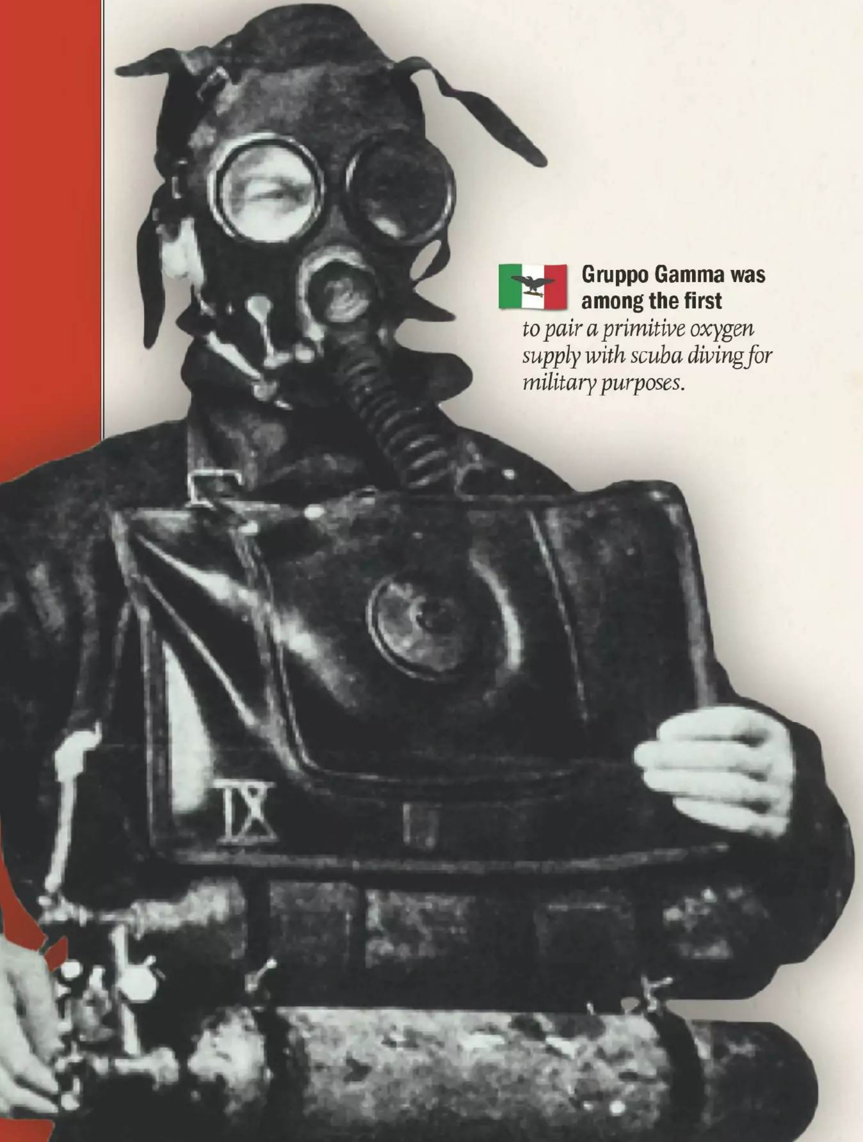
Bob Semple's New Zealand tank *was developed in fear of a Japanese invasion. The vehicle could be built over the body of an everyday tractor.*

This hand grenade *was shaped like a baseball to make it easier to throw. Unfortunately, it was prone to going off prematurely.*

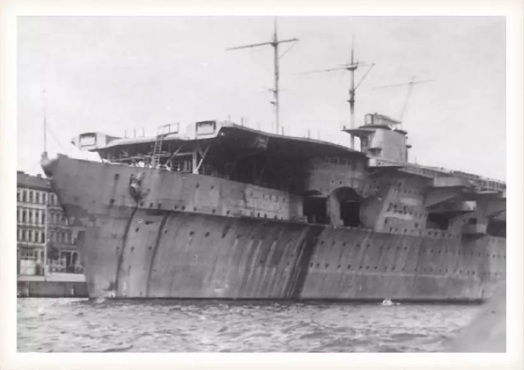
Rotating iron chains hammered into the ground *causing land mines to explode. The Sherman Crab minesweeper saw only limited use, however.*



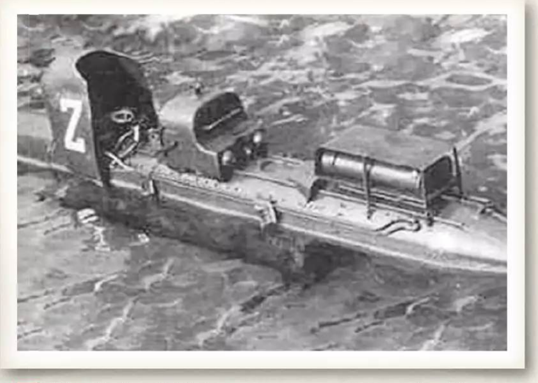
A diving canoe was designed *by the secret British organisation Special Operations Executive. The vessel was used in a few espionage cases in enemy ports and raids on docked ships. The pilot could leave the canoe and place an explosive charge on the side of a ship. The canoe was nicknamed Sleeping Beauty after SOE's chief executive Major Hugh Alleyne Reeves fell asleep in it.*



Gruppo Gamma was among the first *to pair a primitive oxygen supply with scuba diving for military purposes.*



Nazi Germany never quite got an aircraft carrier. *Graf Zeppelin was 85 percent finished when Hitler cancelled work on it due to more urgent projects.*



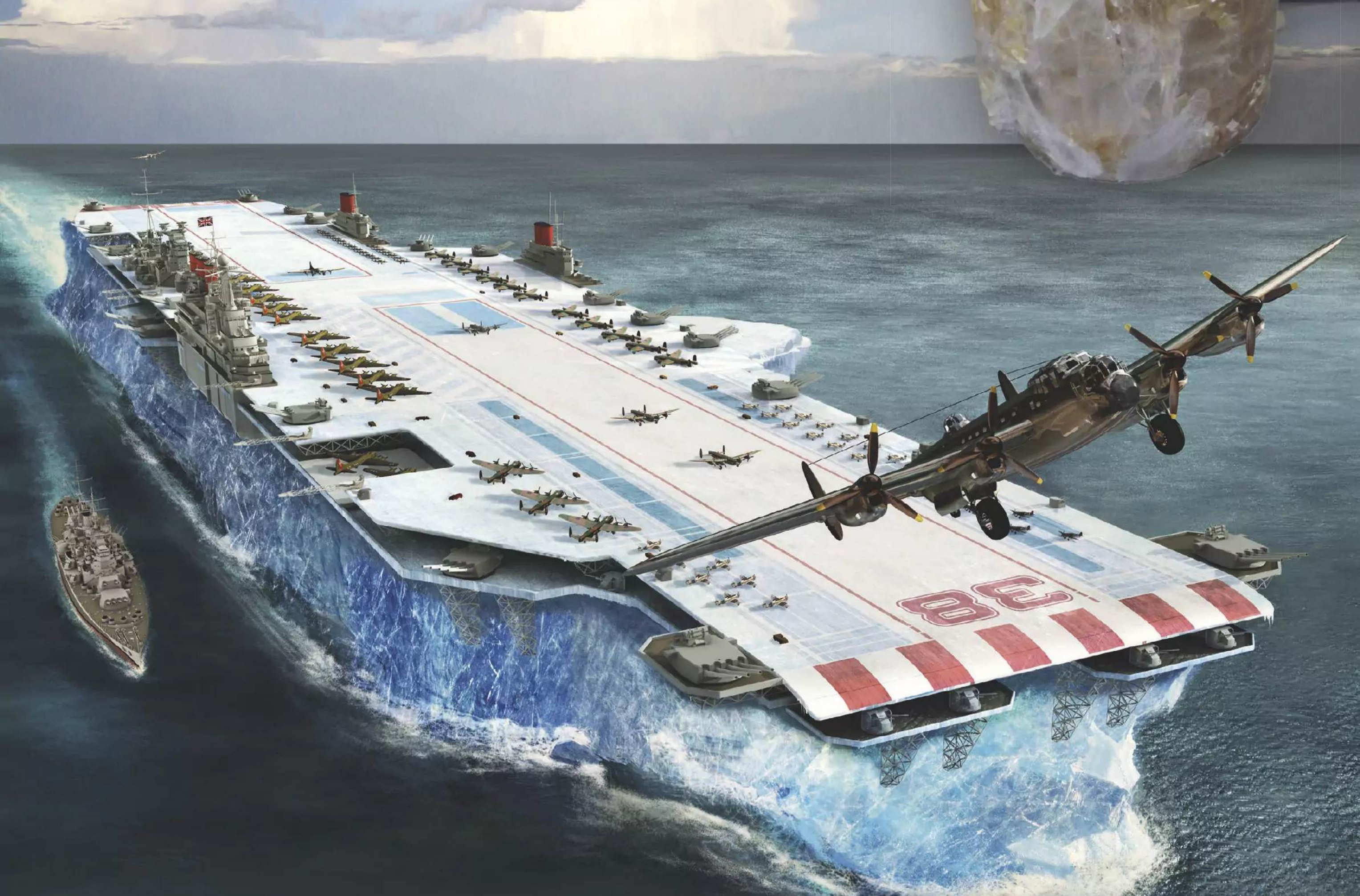
The Italian Maiale was a manned torpedo. *The new weapon was used, for example, to attack the British navy in the ports of Valetta and Alexandria (see page 40).*

Sea mines went to extremes

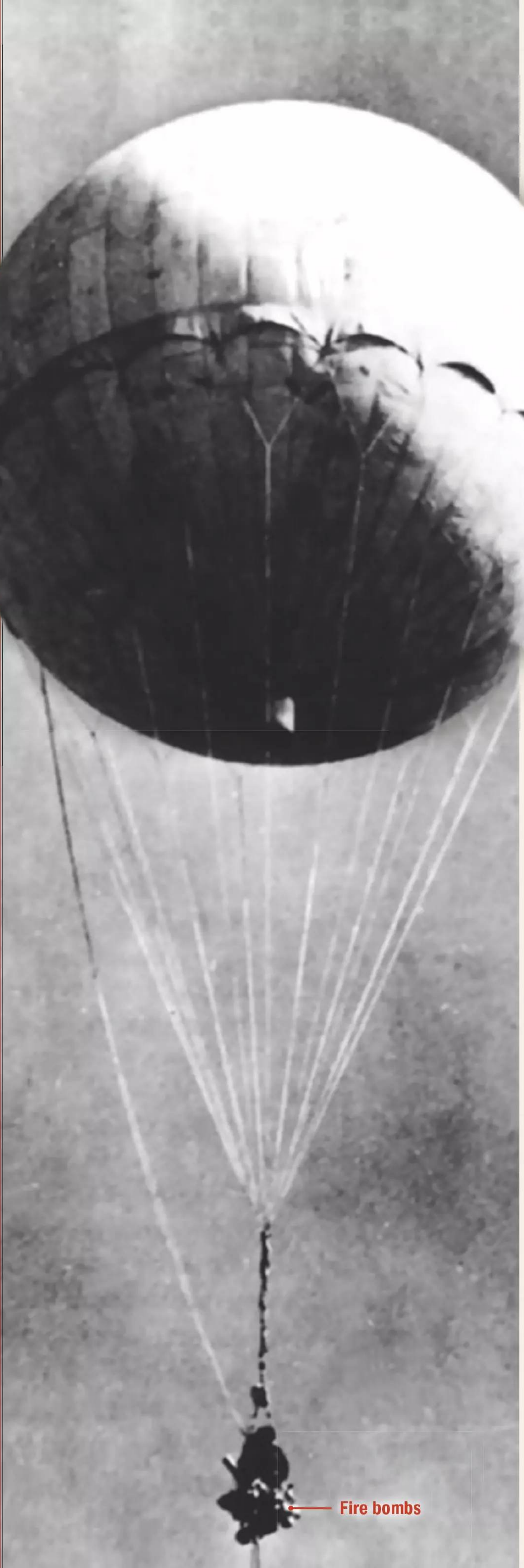
Underwater attacks were an effective way to inflict damage on the enemy with a good chance of getting away unseen. In addition to regular submarines, special units in countries like Britain and Italy worked to create mini-versions of vessels that could be used for raids against enemy ships. The Italians also focussed on divers who could operate on their own under water.

Their size meant aircraft carriers couldn't be hidden, but in turn, they were harder to sink. Germany was close to getting a super aircraft carrier ready while the British were building a floating air base using a new material: ice.

The hull of the ship *would consist of 86 percent ice and 14 percent sawdust – a strong and durable mixture.*



An ice cargo ship was proposed *by British engineer Geoffrey Pyke. Initially, the idea was to build the ship over a natural iceberg, but icebergs tend to roll and melt too fast. Instead, Pyke invented a material consisting of sawdust and ice that would be almost immune to torpedoes. Planning was far advanced, but the war ended before the ship was built.*



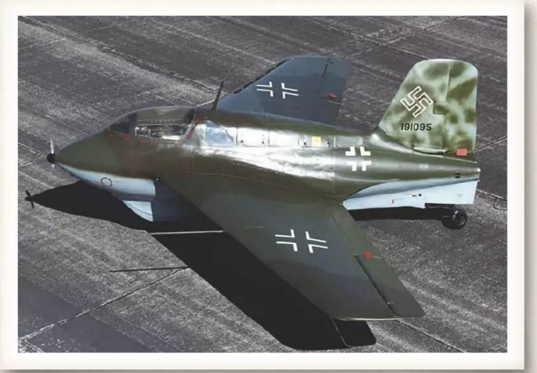
IN THE AIR

Snare attacks were planned

Aerial dominance was critical in most battlefields, but for all the airmen, the problem was reaching the enemy without exposing themselves to unnecessary danger.

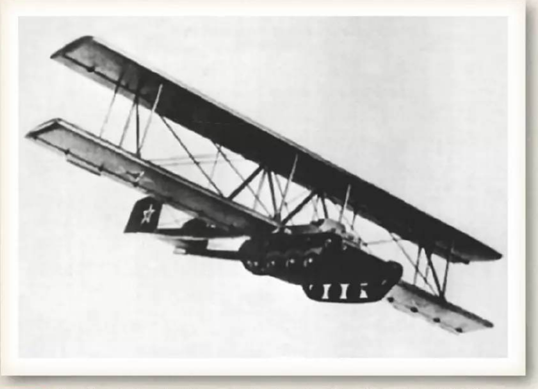
Usually, they attacked at night when planes were harder to detect – or flew low to avoid radar. But more imaginative solutions were also brought into play. For example, Americans employed animals in the US Air Force in the form of a bat bomb that was to be dropped over Japanese cities to set the highly flammable houses on fire.

New and faster planes were also under development, while the Japanese attempted to use so-called fire balloons, which would float with the jet stream across the Pacific to strike major US cities.

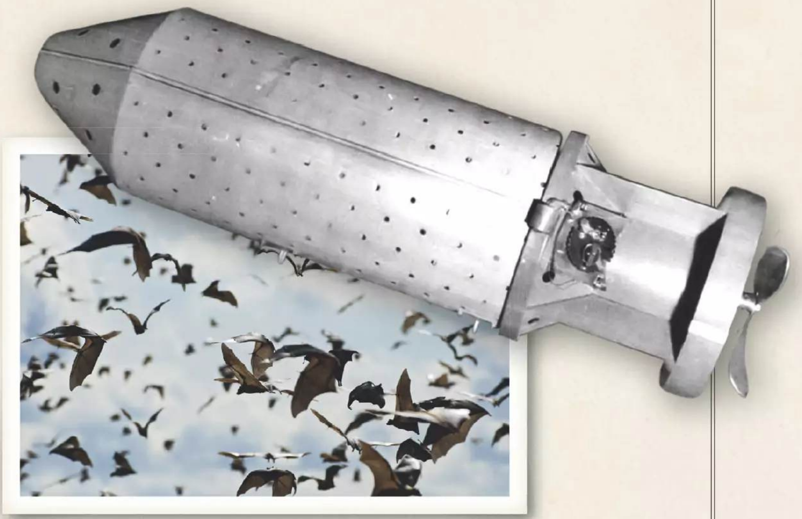


The Messerschmitt Me 163B was rocket-driven, *but flight time was only about seven minutes. The wheels were cast off after take-off, after which the plane landed on its belly.*

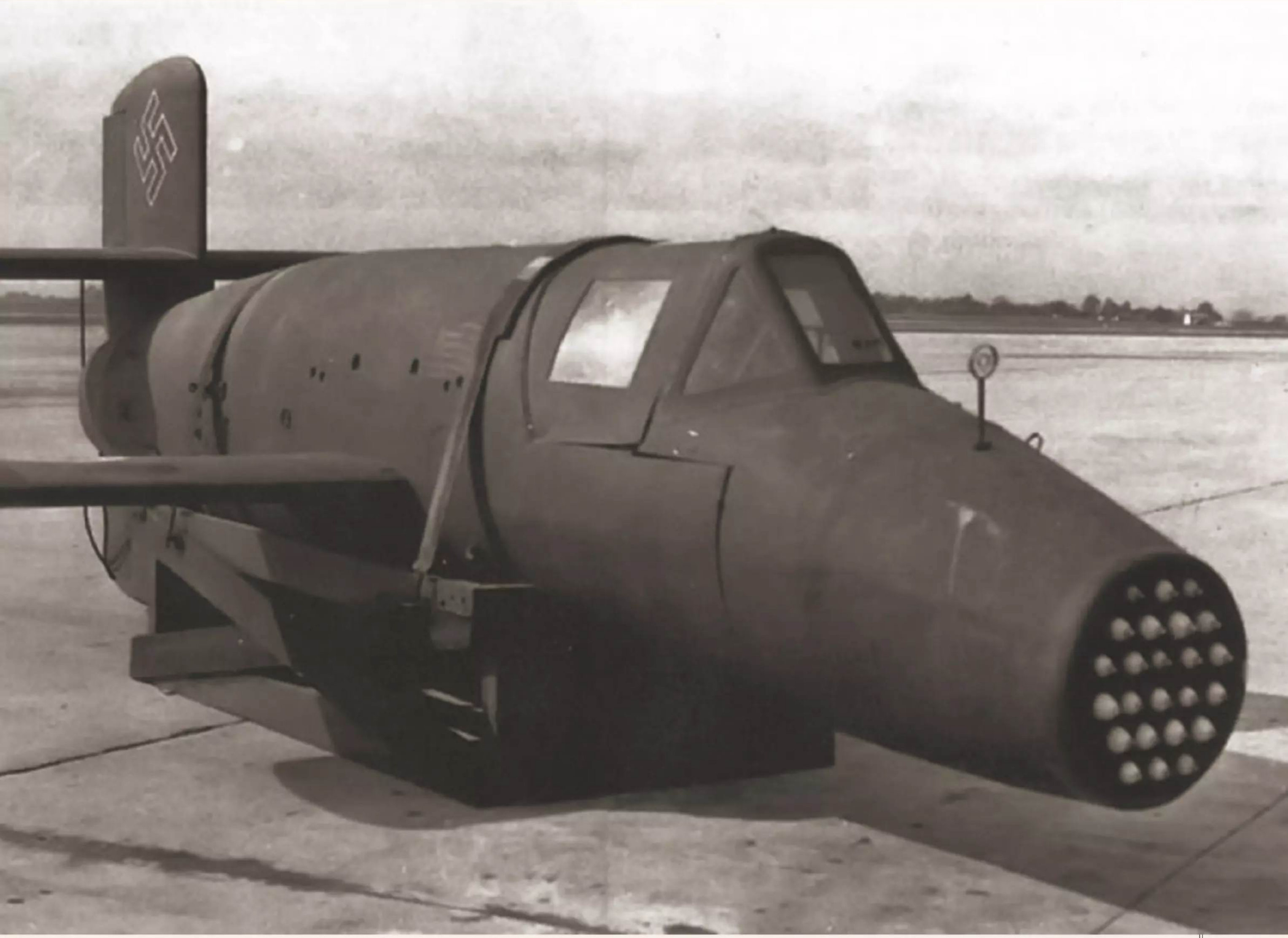
Japanese fire balloons were equipped *with fire bombs designed to explode when the balloons hit the ground. However, the vast majority landed in uninhabited areas.*



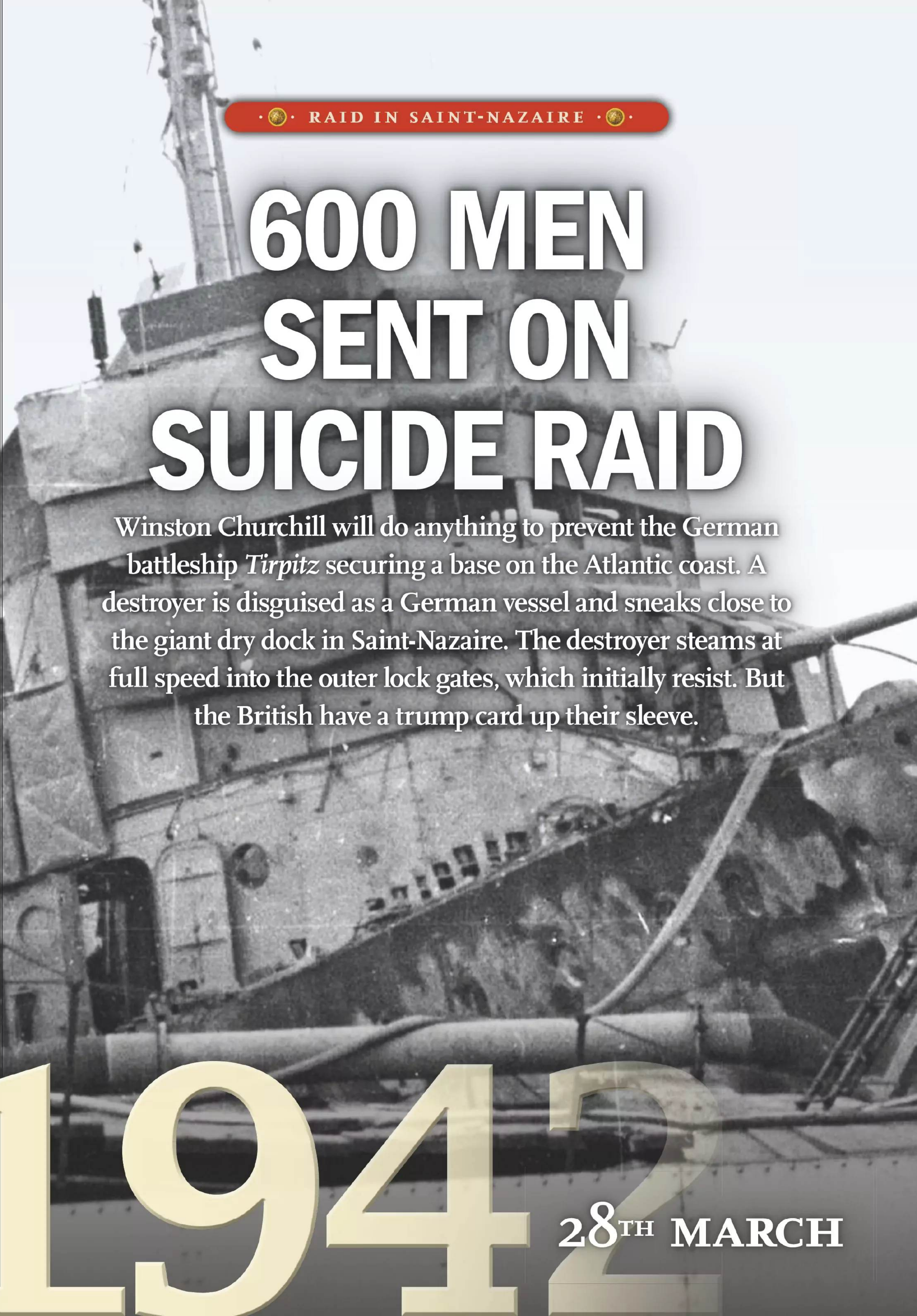
The Soviets delivered tanks to the front, *with the help of gliders. A prototype was built, but a lack of aircraft capable of towing the gliders at sufficient speed meant the project had to be abandoned.*



Hibernating bats, each with a small incendiary bomb attached, *were placed in a container and dropped over Japanese cities. This US plan went deep into development, but was overtaken by the atomic bomb.*



The Bachem Ba 349 was to be launched vertically *when Allied bombers were crossing Germany. The idea was that the pilot fired rockets at the bombers before ejecting by parachute. Also, the rear part of the hull containing the engine was fitted with parachutes, so it could be recovered and reused. The Bachem was never completed and the only manned test flight resulted in the pilot's death.*

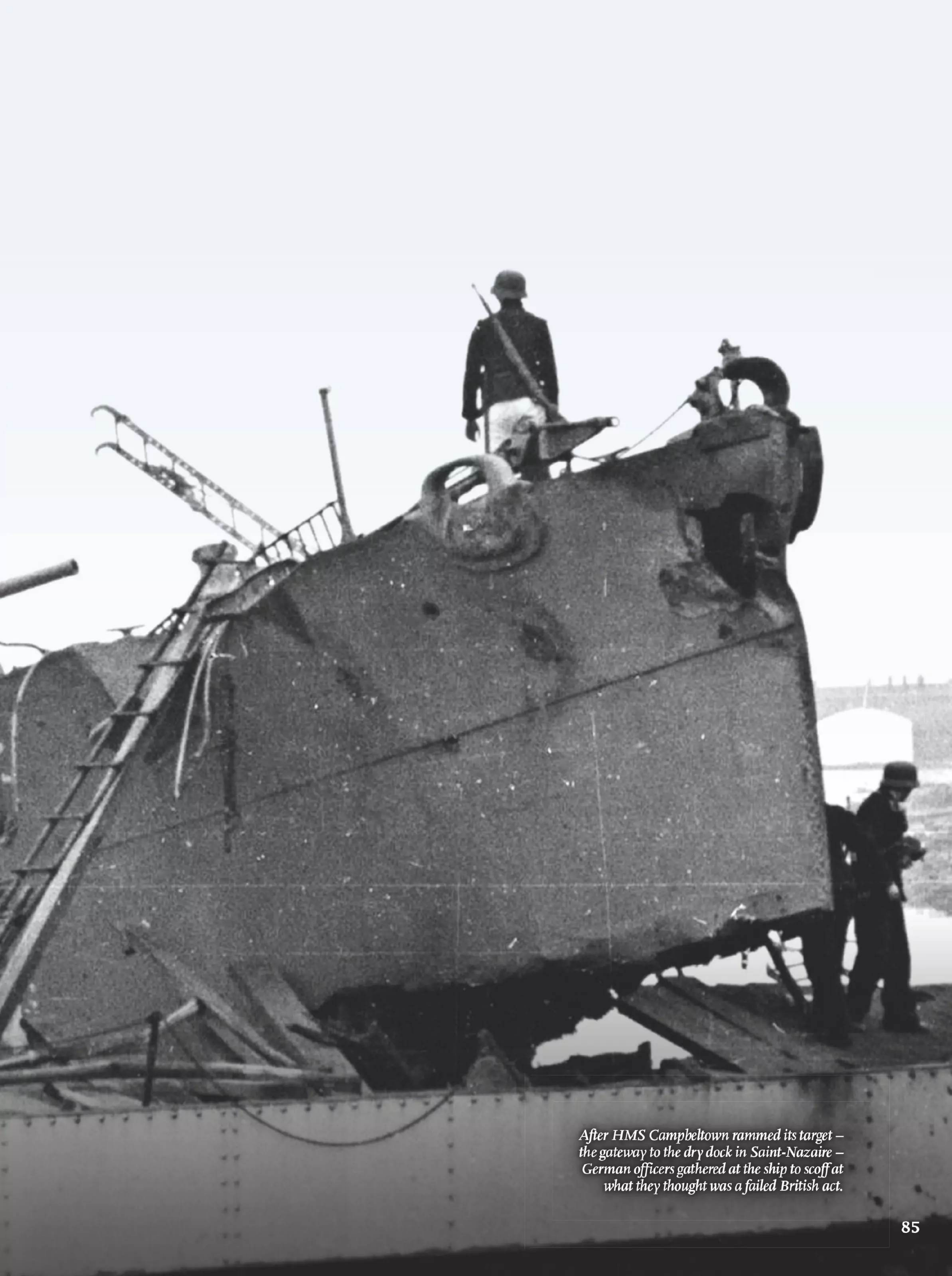


600 MEN SENT ON SUICIDE RAID

Winston Churchill will do anything to prevent the German battleship *Tirpitz* securing a base on the Atlantic coast. A destroyer is disguised as a German vessel and sneaks close to the giant dry dock in Saint-Nazaire. The destroyer steams at full speed into the outer lock gates, which initially resist. But the British have a trump card up their sleeve.

1942

28TH MARCH



After HMS Campbeltown rammed its target – the gateway to the dry dock in Saint-Nazaire – German officers gathered at the ship to scoff at what they thought was a failed British act.

France, 1942

THE STAGE IS SET

In 1942, Britain is pressured on all fronts. The country is the last bastion against Hitler's total dominance in Western Europe and its trade routes across the Atlantic are an umbilical cord. Hitler plans to cut the cord with battleships like *Tirpitz*, but the ships need a port on the Atlantic coast. And only one is big enough.

FRANCE
Saint-Nazaire

5,000 German soldiers were stationed in and around Saint-Nazaire, armed with artillery, machine guns and anti-aircraft guns. Against them stood a British force of 622 men.

OVER 600 BRITISH SOLDIERS HAD GATHERED AT FALMOUTH on the south Cornish coast. The men faced a tense, uncertain wait. For two weeks in the spring of 1942 they'd trained hard and received little sleep. Only now were the soldiers told what mission they'd been assigned to. The target was the port city of Saint-Nazaire in the west of German-occupied France, where the Third Reich had built the world's largest dry dock – the only one on the Atlantic coast that could accommodate the battleship *Tirpitz*.

Tirpitz posed a daunting threat to the merchant ships that Britain was dependent on. If the shipping routes with the US broke down, the British would have no chance of preventing Hitler from invading the country.

Prime Minister Winston Churchill had made the destruction of *Tirpitz* the highest priority, one bordering on obsession. "The destruction or even crippling of this ship is the greatest event at sea at the present time", he stated. "No other target is comparable to it". At every opportunity he would stress the outcome of the war might depend on their ability to take *Tirpitz* out of action, and one of the main objectives in delivering that goal was to destroy the only Atlantic-based dry dock large enough to house the ship when it required maintenance or major repairs.

Churchill believed for a long time that it was best to let the French Resistance destroy the dry dock. That plan was dropped, however, when it was realised the saboteurs would be unable to transport sufficient explosives. A massive aerial bombing campaign was also dismissed, because Churchill feared it wouldn't be accurate enough and would take the lives of many civilians. Thus, an attack from the sea was the only option.

The seriousness of the situation was rapidly made clear to the 600 soldiers in Falmouth. They were told it was a highly risky operation and that many would die. If they chose to opt out, then there would be no consequences for their careers in the armed forces. Not a single one backed out.

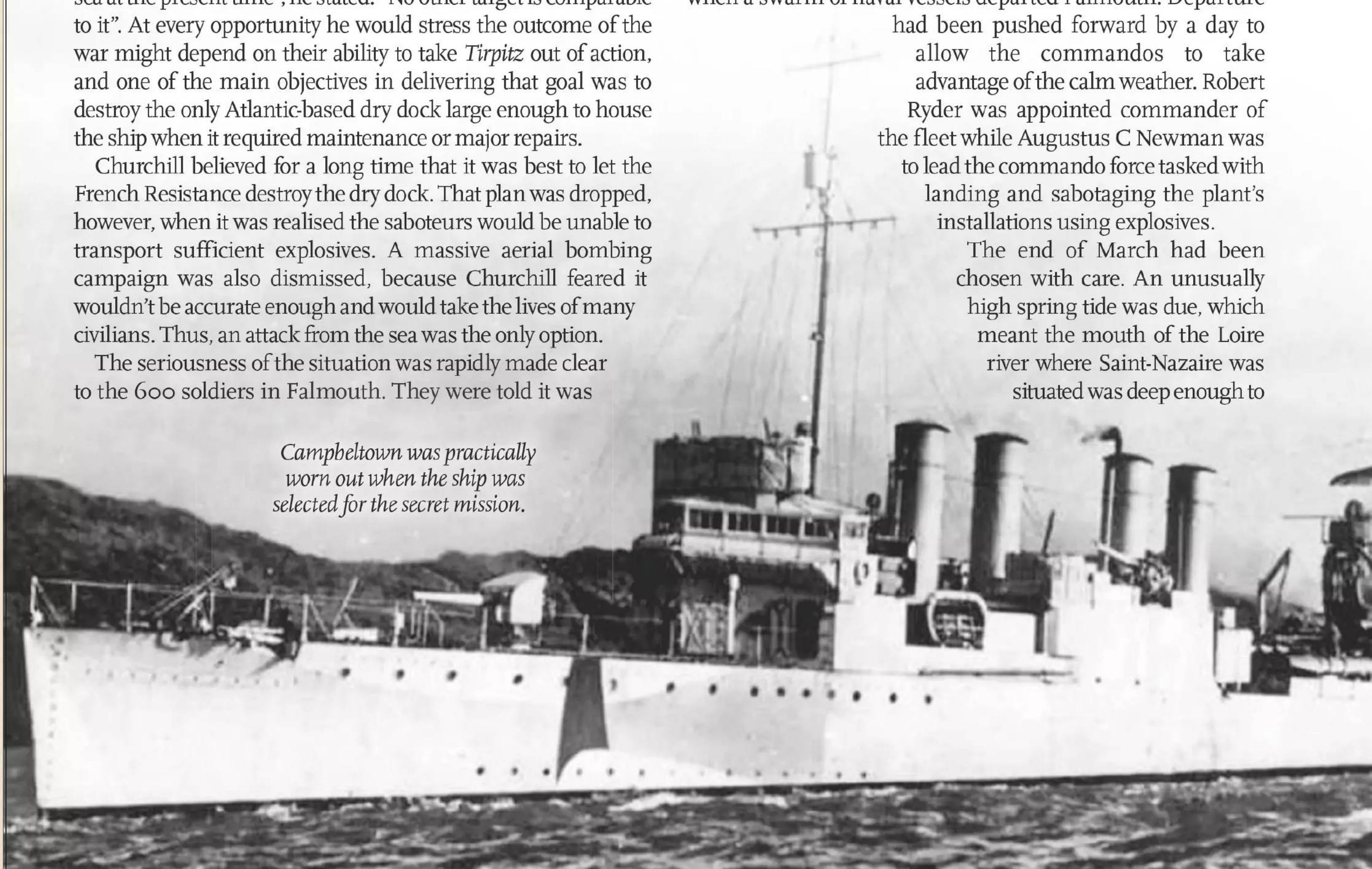
The date was 25th March, 1942, and the operation was christened Chariot. It would be a swift surprise attack.

SPRING TIDE PROVIDED MISSION WITH UNIQUE OPPORTUNITY

The weeks leading up to the mission had seen the soldiers train in local ports. One group had practised in Cardiff, another in Southampton. Both had practised mock assaults on cranes, ships and pumps that – according to intelligence – were similar to the equipment at Saint-Nazaire's port. The commandos had learned all the dry dock's weak points and had exercised so intensely they could almost perform blindfolded.

Two days later, on 26th March, the serious business began when a swarm of naval vessels departed Falmouth. Departure had been pushed forward by a day to allow the commandos to take advantage of the calm weather. Robert Ryder was appointed commander of the fleet while Augustus C Newman was to lead the commando force tasked with landing and sabotaging the plant's installations using explosives.

The end of March had been chosen with care. An unusually high spring tide was due, which meant the mouth of the Loire river where Saint-Nazaire was situated was deep enough to


Campbeltown was practically worn out when the ship was selected for the secret mission.

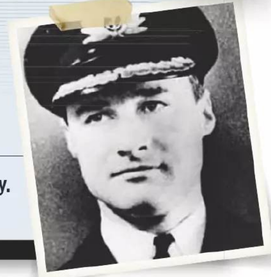
The Victoria Cross remains the most prestigious award for valour against the enemy.

NAME **ROBERT RYDER**

TITLE NAVAL FORCE COMMANDER

Warrior was highly decorated

After Robert Ryder's ship, *Prince Phillippe*, sank in 1941 after a collision in the Firth of Clyde, he found himself without a mission. The commander was selected to lead the Saint-Nazaire raid, which he conducted with great skill. After the attack, Ryder succeeded in escaping and – along with four others – received the Victoria Cross (two received it posthumously). After the war, Ryder went into politics.



- **Received the Victoria Cross for bravery.**
- **Was later a Conservative MP.**

allow the fleet to head directly into the harbour rather than following a winding – and heavily defended – dredge channel. Meanwhile, if the Germans discovered the flotilla of ships, they'd likely believe it was heading to the large naval base at Gibraltar.

The fleet consisted of 19 vessels, 13 of which were small and light motor launches, each with a mahogany veneer hull so thin it could be holed by a rifle shot. On the deck stood tanks with extra fuel, so each boat could return to England under her own power. These tanks made the launches a highly flammable target, although on the upside they were fast.

A gunboat and four larger torpedo boats would remain at sea away from the estuary to gather up the troops as they – hopefully – returned from the mission.

DEADLY CARGO CONTAINED HIDDEN BOMBS

The armada's flagship was *HMS Campbeltown* – an obsolete destroyer that had been built in the US in 1919. The vessel had been stripped of all superfluous equipment to make her sit lightly in the water, although the bow was reinforced with extra heavy steel plates to withstand an anticipated bombardment.

The ship's most important cargo was below decks: 24 depth charges containing a total of just over four tonnes of explosives. The bombs were camouflaged by laying them in steel tanks and then embedding the tanks in concrete. The plan was for *Campbeltown* to sail up close to the heavy sliding door that protected the dry dock. After colliding with it, commandos would run ashore to sabotage the dock's installations. By 08.00 the following morning, the huge explosive charge would detonate and destroy the door – if the timer worked. The concrete camouflage was designed so that if German troops boarded the ship, they wouldn't recognise the bombs and frustrate the operation.

In addition, *Campbeltown* had been radically refitted to closely resemble a German Möwe-class destroyer. To add credibility to her disguise, *Campbeltown* would sail under the swastika flag.

U-BOAT LURKED BENEATH THE SURFACE

The weather was perfect as the fleet sailed south on the morning of 27th March. In fact, Commander Ryder felt visibility was too good. He was proved right when at 07.00 the armada was spotted by the German submarine *U-593*. The fleet's two destroyers spent a couple of hours pursuing the U-boat, dropping depth charges without success. On the other hand, they forced the sub to remain submerged, preventing the crew from making radio contact. It wasn't until 14.20 – more than seven hours later – that the U-boat commander resurfaced and reported on the British convoy. He estimated – just as the British had hoped – that they were minelayers bound for Gibraltar. By this time, the fleet had changed course and was heading east towards the French coast.

At 18:30 one of the launches developed engine problems and had to return home. Another challenge arose when the British encountered a whole fleet of French fishing boats. They feared German observers were on board, but with so many boats they had to settle for inspecting only a few. When the fishermen swore that there were no Germans or radios onboard, Ryder risked believing them and continued approaching the coast.

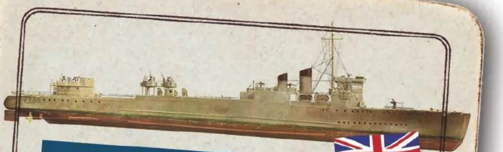
Early in the evening, the fleet approached German-occupied France. Darkness fell, and to Ryder's satisfaction, it turned cloudy. At 22.15, they passed the British submarine *Sturgeon*. The vessel had sailed ahead and remained in a fixed position a short distance from the entrance to Saint-Nazaire. Her role had been to continuously transmit radio signals to guide navigation, providing a direct line that would lead straight to the target.

FLEET SAILED INTO THE LION'S JAWS

Immediately after rendezvousing with the *Sturgeon*, 16 of the fleet's 18 vessels assumed battle formation, and from here they sailed directly into the Loire's mouth and started heading upriver.

The Motor Gun Boat *MGB 314* sailed at the front of the formation with radar and sonar onboard. It was followed by two Motor Torpedo Boats (MTBs), then HMS *Campbeltown*, and finally the numerous motor launches.

MGB 314's sonar proved vital, for although it was high tide, there wasn't much water in the estuary. *Campbeltown* extended almost four metres below the surface, and twice her hull noisily scraped over one of the river's many sandbars. All aboard held their breath, but each time *Campbeltown* managed to free herself. The convoy's speed was around 12 knots, or 22 km/h. It was completely dark and for now everything proceeded smoothly.

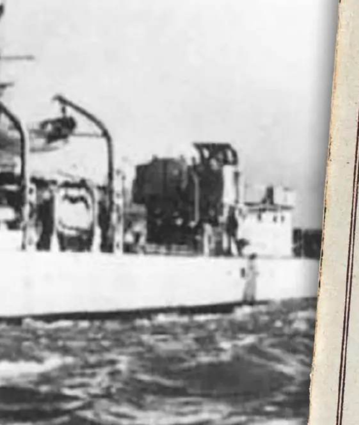


HMS Campbeltown

Launched (as USS Buchanan)	1919
Transferred to Britain	1940
Length	96 metres
Weight	1,260 tonnes
Draft	3.7 metres
Top speed	35 knots (65 km/h)

BRITONS INHERITED OLD SHIP

In 1940, the US decided to help the British. An agreement was made whereby the British received 50 older destroyers in return for giving the US the right to establish bases on British soil. One was the USS Buchanan, which was renamed HMS Campbeltown.



At midnight, an explosives expert aboard *Campbeltown* primed the timer, set to detonate the four tonnes of explosives eight hours later. The mechanism triggering the explosion was primitive – acid slowly eating through a layer of copper. When the copper was eaten through, the current would be terminated to set off the explosion.

The flotilla passed a German radar station without being detected, and at 00.30 they sailed – almost miraculously – past one of the dreaded coastal batteries without being fired upon.

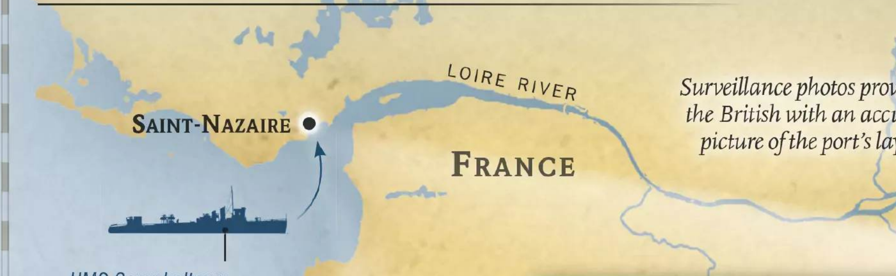
It was also quiet inside Saint-Nazaire. The harbour was an important submarine base for the German Kriegsmarine, and the whole city was heavily guarded. Around 5,000 German troops were stationed in the city, which had been transformed into one huge fortress. Coastal batteries, long-range guns and a host of searchlights covered the entire estuary, which meant the fleet could find itself under heavy fire from artillery of all sizes. The city was also considered an obvious bombing target and so was packed with anti-aircraft guns.

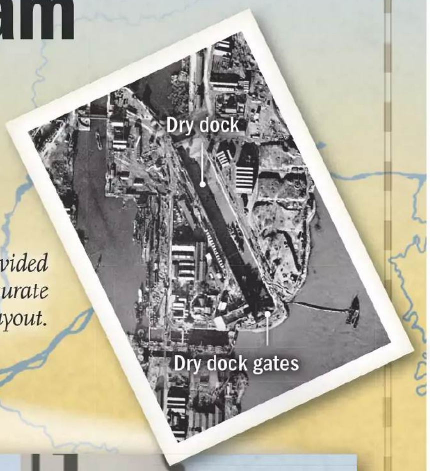
Devilry was afoot

The previous day a German admiral had visited the city and asked its commander, Lieutenant Commander Herbert Sohler, what he would do if the Brits attempted to attack the port from the sea. "It would be out of the question for the

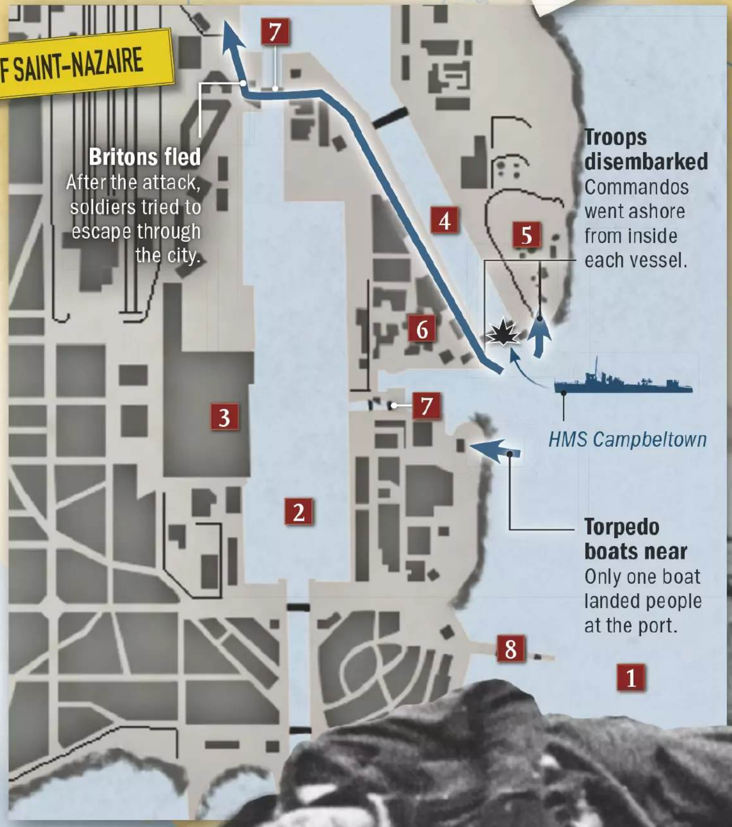
Ship served as battering ram

***HMS Campbeltown* was sailed at full speed towards the gate of a dry dock in Saint-Nazaire. The Germans were fooled into thinking the destroyer was just out of control.**





Surveillance photos provided the British with an accurate picture of the port's layout.



Britons fled
After the attack, soldiers tried to escape through the city.

Troops disembarked
Commandos went ashore from inside each vessel.

Torpedo boats near
Only one boat landed people at the port.

Harbour was crippled

Attack would not only destroy the dock, but also other installations at the port.

1 **Loire river.**
2 **The deep-water main base** lay at the heart of the great port, which served as one of the German Navy's principal support points in France.
3 **The submarine dock** was reinforced with concrete up to five metres thick, which protected the submarines from Allied bombs.
4 **The dry dock** was the only one in occupied Western Europe big enough to accommodate battleships such as *Tirpitz*.
5 **Underground depots** contained large amounts of marine fuel.
6 **The pump house** made sure the dock was fully drained and was also a target for destruction.
7 **Sliding gates** provided access to the docks.
8 **The Old Mole pier,** where British soldiers were to be landed and picked up again.

English to enter the harbour", was Sohler's dismissive reply. To distract the Germans' attention from the river, the RAF had planned a raid on the port the same night, but cloudy conditions allied with fewer planes being deployed than agreed meant the attack was a half-hearted one.

Some of the British planes continued to circle the city, every now and then dropping a single bomb. But the lack of any major bombardment made German commander Karl-Conrad Mecke suspicious.

"Some devilry is afoot", he told one of his officers, and at midnight he ordered that everyone should be on high alert. Mecke guessed the British planned to parachute in and ordered all lights in the harbour switched off, making it harder to find.

Ironically, his orders had the opposite effect, helping the British flotilla as it neared its objective. The crews were surprised to reach the estuary mouth without being met by dazzling searchlights or the least resistance. "This is almost too good to be true", was the murmur on board many of the ships.

And it was. At 01.20, the alarm was raised to all German troops:

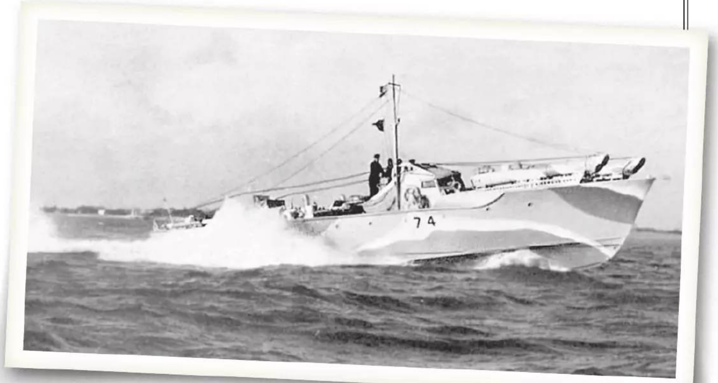
"Beware landing".

A moment later, spotlights located the British boats on the dark water, but after a brief round of light cannon fire, there was a break in the shelling. The bluff of making *Campbeltown* resemble a German destroyer appeared to be working, and the swastika flag confused the Germans for a few precious seconds. German defenders then flashed light signals to the ship, but the British were prepared. *Campbeltown* responded with its own signals:

"Wait! Urgent: two craft damaged by enemy action, request permission to proceed to harbour without delay", the message flashed in German.

For a brief period, the Germans halted their shelling – a second flurry of gunfire was temporarily halted when *Campbeltown* signalled "You are firing on friendly ships", but the game was soon up. The bluff had been called and all hell broke loose. Guns fired from both banks of the estuary and the British crews began to return fire as best they could.

"The Greatest Raid of All" is Operation Chariot's epitaph in military history. It went on to inspire several other raids as well as the 1967 film, "Attack on the Iron Coast".



Fast motor launches were deployed to bring the British troops to safety after the raid, but the light ships were extremely vulnerable.

The Germans concentrated their fire on *Campbeltown*, bombarding her with shells. Several fires had started, but although her captain – Lieutenant Commander Stephen Beattie – was blinded by the spotlights, he resolutely ordered full speed ahead. *Campbeltown* sped up to 20 knots, but then her helmsman was hit and died on the spot. The quartermaster took his place, but was also quickly shot, leaving demolition specialist Lieutenant Nigel Tibbits at the helm. The course was set directly towards the massive southern gate and just before *Campbeltown* roared into it, Beattie yelled a warning to all the commandos on board: "Stand by to Ram!"

The destroyer tore through the gate's anti-torpedo net that had been laid to protect it and at 01.34, the old destroyer sped into the entrance to the dock with such force that the bow of the 1,000-tonne ship lifted over the gate and her forward compartments crushed reducing her length by 10 metres.

As planned, this meant the huge explosive charge in the ship's forward compartments were embedded next to the sliding gate, while the acid was now slowly but surely eating its way through the copper layer. The moment it reached the explosive core it would set off a lethal blast that would hopefully destroy the gate and flood the dry dock. If

The bodies of many of the 168 dead British soldiers were left for several days in the port of Saint-Nazaire.

the explosive failed, it was imperative that the destroyer couldn't easily be removed – Beattie immediately ordered some of his men to blow holes in the ship's hull.

350 metres
was the length of the dry dock at Saint-Nazaire. Its width was 50 metres, and its height 15.25 metres, allowing it to accommodate the largest battleships.

Commandos went ashore

The raid wasn't purely concerned with taking out the dry dock. The British commandos were also tasked with destroying as many facilities as possible within the strategically vital port. Immediately after *Campbeltown* ploughed into the sliding gate, the first commandos disembarked and began the mission they'd trained so diligently in the ports back home.

Many of the soldiers were heavily laden with explosives, so only able to defend themselves with guns. Others were more heavily armed to serve as a vital support group.

One important target was to blow up the pumps and machinery used to drain the docks of water. Fortunately, the intelligence about the pump house in Saint-Nazaire proved correct, the building closely resembling the facsimiles the solders had trained in. Despite the fact many soldiers were wounded as *Campbeltown* ploughed into the gate, it was a quick job to place the explosives in the correct locations, including the pumps themselves 12 metres below the surface. The man lighting the fuse – Lieutenant Stuart Chant – was among the injured, but despite having taken gunfire to the leg, he was able to limp up the stairs towards the pump house's entrance, step-by-step. He had 90 seconds to make his escape – and he succeeded.

Campbeltown's official emblem contained branches from the myrtle plant.

The explosion from the pump house was enormous, and the men couldn't resist running back to watch. They were satisfied: the destruction was total. Not only were the pumps blown to pieces, but large cracks had developed along the thick concrete floor.

The commandos could now embark on their secondary objectives, including the two winding sheds that contained the machinery to open and close the gates to the dock. Another target on the list was the plant's underground fuel depots.

The two winding sheds were destroyed, but the northern sliding gate proved to be inaccessible and too well covered by German machine gunners. The mission's ultimate success would now rest on the explosives in the *Campbeltown*'s hold, up against the southern gate, making the dock unusable.

Motor launches ablaze

While everything went to plan for the surviving commandos on *Campbeltown*, it was much harder for the soldiers in the small motor launches.

The plan was for them to land on the "Old Mole" pier, but the flimsy boats were under heavy fire from the 20-mm machine guns that the Germans had installed on the quay. Several motor launches were alight after the Germans hit the

Those British soldiers who were captured were gathered at the port and later transferred to prisoner-of-war camps in Germany.

fuel tanks on deck, and now they were failing to land at the pier, which was far more closely guarded than expected. The motor launch *ML 192* was hit by a large shell, killing many on board and leaving the boat so incapacitated that her captain could no longer control her. He immediately issued an order for all survivors to immediately abandon ship.

Another launch – *ML 457* – did manage to succeed in landing 20 commandos, whereas five sister ships had to retreat. *ML 192's* assault group commander – Captain Michael Burn – also managed to swim ashore in full combat gear. The plan had been to land 70 soldiers. Meanwhile, chaos reigned on the Loire. Burning boats and debris bobbed around, some soldiers jumped into the water, while others cried in pain. The German shelling continued, relentlessly.

The 20 soldiers who made it ashore soon found themselves in the middle of a nightmare. First, they were forced to run the gauntlet of enemy fire on the Old Mole, and those who made it through were then forced to cross an open space where they were easy prey to German guns. Quickly, it dawned on them there were no reinforcements coming, but nevertheless they managed to blow up two French tug boats. On the other hand, it was impossible to destroy their main designated target: a bridge crossing the southern entrance to the port.

At the same time many commandos who were put ashore after *Campbeltown*'s brutal collision with the sliding door were also running in trouble. The original plan was that they'd have to make their way back towards *Campbeltown* from where they'd be picked up by one of the other ships. In the meantime, however, the Germans had taken *Campbeltown*, so the soldiers would instead have to look towards the old pier where they hoped the motor launches would be able to take them onboard.

But that plan had to be abandoned too. The Old Mole never came under British control, so now a back-up plan came into force. It sounded short and sweet: the commandos were to fight their way through the town and into open country, and from there head south through Spain to Gibraltar. The instructions were clear, but no one was

The port of Saint-Nazaire was covered by debris from destroyed buildings as well as metal pieces ripped from damaged pipes and equipment. It took days to extinguish all the fires, and the firemen discovered many bodies of soldiers and civilians who'd been looking at Campbeltown.

enthusiastic: the road to Gibraltar was 1,700 kilometres through occupied France and fascist Spain.

The commandos divided into smaller groups and started making their way through the port area in search of the old town of Saint-Nazaire. It was still pitch black, with Germans teeming everywhere. Several British soldiers were killed making their way through an open space, and more lost their lives traversing the bridge linking the port to the city. Here the Germans stood ready with machine guns, and only when 40-50 commandos stormed the bridge were they able to displace the German guards. Most British soldiers escaped alive across the bridge, but the old town was a labyrinthine tangle of narrow streets, and soon they started to separate.

228 soldiers

out of the 622 men deployed to Saint-Nazaire returned to Britain after the raid. Five of them had to travel all the way through France and Spain.

THE TOWN WAS SURROUNDED

The Germans hadn't been idle – they'd called for reinforcements, and soon the first motorcycles arrived from the nearby 679th Infantry Regiment. They paired up with local troops to surround the town and begin a house-to-house search, capturing the British one by one – many of them wounded. 15 found refuge in a basement where they managed to evade capture all night, but the game was up when they were discovered the following morning.

The situation on the river was equally desperate. Many of the motor launches were incapacitated, and those few that could still navigate were limping back out to sea – some at half power. The river's water was full of corpses, and although their orders read that the commanders should not stop to collect the wounded, Lieutenant Wynn on *MTB 74* couldn't bear to sail past a rubber raft with two British soldiers. He gave the order for a full stop, and shortly after *MTB 74* came alongside the raft. Unfortunately, this placed the boat directly in the firing line of one of the German guns on the coast. Two large shells set the torpedo boat on fire, and Wynne was forced to order his crew into the water.

SEA RESCUE HAD VANISHED

The British were easy prey during the retreat. Despite this, several of the small boats managed to get out to sea in the direction of *Tynedale* and *Atherstone*, the two destroyers that were lying in wait around 40 kilometres off the coast. Here the crews waited to receive the many wounded, but the ships weren't at the agreed position. They'd ended up in a fierce firefight with German torpedo boats and had been forced off-course. A few badly damaged British boats managed to find their rescuers at around 04.30 that morning, but three of the motor launches escaping the port at Saint-Nazaire were – with little power and badly wounded crews – forced to limp back to safe harbour in England.

Some didn't even have that option. Motor launch *ML 306* met five German motor torpedo boats as she made her way across the open sea. At first, the captain switched off the engine and hoped for the best while he and the crew waited silently in the darkness. Four of the German vessels passed the British boat within 100 metres without spotting her, but when the Germans aboard the fifth boat switched on a searchlight they immediately detected *ML 306* and raised the alarm. Immediately all five boats circled *ML 306* like predators closing in on prey.

The Germans expected the British commander to surrender immediately, but it was only after a prolonged firefight that the men aboard *ML 306* gave up when the German captain of Jaguar, one of the five torpedo boats, repeatedly called in broken English to give up the fight, assuring those on board they'd not suffer further damage. By that time, 20 of the 28 crew members had either been killed or injured.

TOWN RESIDENTS TOOK UP ARMS

Next morning Saint-Nazaire's residents woke up to a sight of extreme destruction. Heavy smoke hung over the town, and the bodies of German and British soldiers littered the ground. Many shelled buildings were still raging fires and the surviving defenders were on full alert. They assumed enemy forces still hid in many of the city's old houses, narrow courtyards and deep cellars.

The Germans were so nervous during their search that they repeatedly opened fire, and in several cases shot at each other.

The tense situation wasn't helped by the fact several of the city's French residents mistakenly believed the attack was the beginning of the liberation of their occupied nation. On their own, they began to attack the already confused Germans with handguns.

The raid in Saint-Nazaire was carried out by Royal Navy commandos.

Along the banks of the Loire, bodies also floated around while individual survivors were pulled from life rafts – and immediately captured by the Germans.

The raid appeared to have failed

By 08.00, it was six and a half hours after *Campbeltown* had slammed into the dry dock's gates and the raid on the port's installations had begun. The destroyer still rested with her bow on top of the gate. The 24 depth charges embedded in concrete in the ship's cargo containers should – at this precise moment – crush the bow of *Campbeltown* and destroy the gate to the dry dock. But nothing happened. The explosive hadn't fired and the surviving Britons assumed their sacrifice had been in vain.

The Germans investigated *Campbeltown* thoroughly, but no one twigged what the concrete was doing near the bow. They assumed it was designed merely to increase the force of the collision, and the mood around the boat was almost cheery.

"If this is all you could do, was your raid really worth it?" was a typical sneer to the prisoners.

There were swarms of German and local French sightseers on the boat. The weather was beautiful, and officers arrived in large numbers, several in the company of French friends. Gradually, several hundred people gathered around the stricken ship.

At 10.35, two and a half hours later than planned, there was an explosion that made the entire town tremble. *Campbeltown* exploded into two pieces, raining down red-hot metal parts, debris and broken glass over Saint-Nazaire. In a short time, the dry dock was filled as water flooded through the gaping hole in the gate.

Body parts from the bystanders draped over cranes and masts. The explosion was so powerful that two large tankers were thrown against a neighbouring quay with such violence that they sank.

The explosion set off total panic in town. The Germans couldn't comprehend what had happened, and thought they were being subject to another raid. They saw enemies everywhere and shot freely at anything and everyone. The losses mounted, and *Campbeltown*'s destruction brought with it the loss of 250 people. Most importantly, however, the dry dock was destroyed so effectively it would only be repaired after the war's end.

Although the Germans captured most commandos, five Britons managed to escape from Saint-Nazaire. Help from the local Resistance and other French people, allied with a difficult detour, allowed four of them to successfully go through France and Spain to Gibraltar. One was arrested and imprisoned in Bordeaux, but after eight months in captivity he managed to escape and move on to Spain. Like his four compatriots, he returned to Britain where all five signed up once again for active service.

The guns on Tirpitz would have been a major threat to the Allies if the ship had been able to operate freely.

PERSPECTIVE

Atlantic was put out of reach

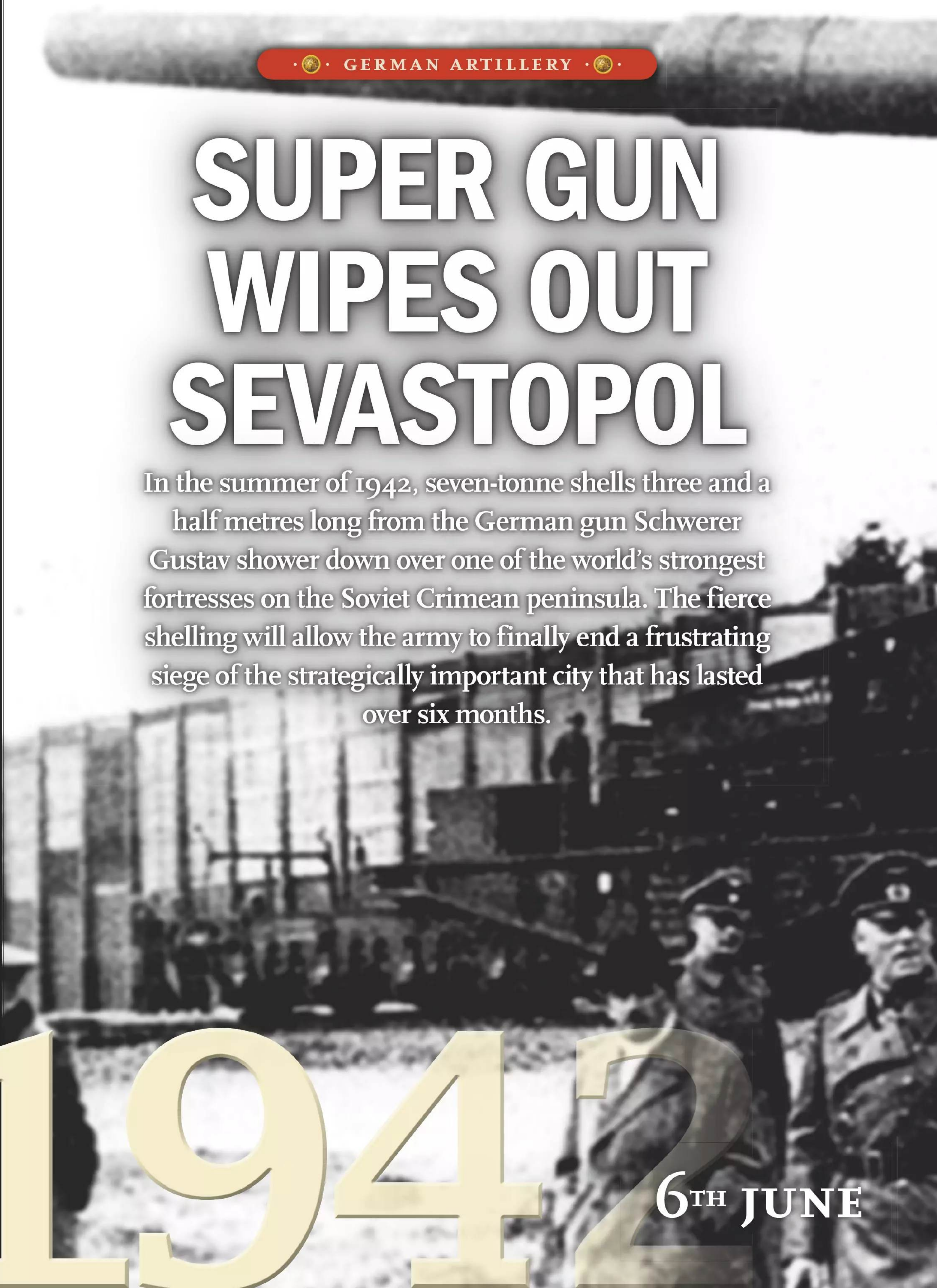
The action in Saint-Nazaire destroyed the dry dock so completely that the Germans abandoned trying to fix it. Battleship *Tirpitz* was left homeless in the Atlantic.

Hitler's plan was that the largest German battleships ever built – *Tirpitz* and her sister the *Bismarck* – would isolate the UK and, with help from U-boats, cut off vital supplies to the island nation.

Churchill was aware of the threat and made every effort to prevent the ships gaining free rein. The Royal Navy had already sunk *Bismarck* on her maiden mission, and the destruction of the dry dock at Saint-Nazaire meant no Atlantic ports in occupied Europe could accommodate *Tirpitz*. Instead, German naval command ordered *Tirpitz* to remain in the waters around Norway. Here, the battleship took part in several operations, but never played a major role.

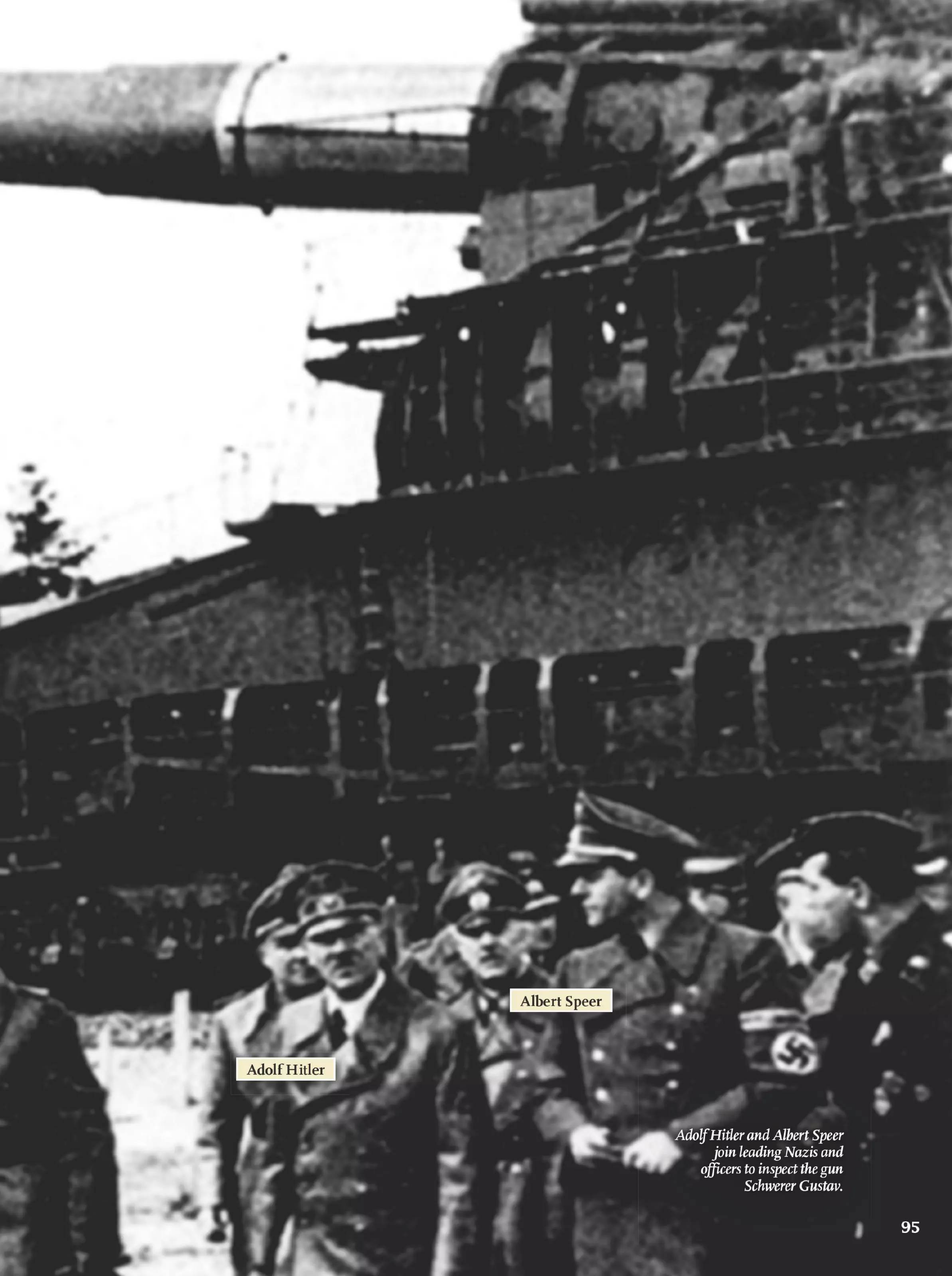
SUPER GUN WIPES OUT SEVASTOPOL

In the summer of 1942, seven-tonne shells three and a half metres long from the German gun Schwerer Gustav shower down over one of the world's strongest fortresses on the Soviet Crimean peninsula. The fierce shelling will allow the army to finally end a frustrating siege of the strategically important city that has lasted over six months.



1942

6TH JUNE


Albert Speer
Adolf Hitler

Adolf Hitler and Albert Speer join leading Nazis and officers to inspect the gun Schwerer Gustav.

THE STAGE IS SET

In 1941, gun manufacturer Krupp supplies Hitler with a heavy gun more than 40 metres long and weighing 1,350 tonnes. The weapon arrives too late for its intended target of France, but in 1942 Hitler sees the steel monster as a solution to the Crimean problem, where the gun will crush the strong fortress at Sevastopol.

SOVIET UNION
Sevastopol

By the 1930s workers at Krupp already had steel safety helmets.

SEVEN TONNES OF ARMOUR-PIERCING SHELLS flew through the air near the port city of Sevastopol in the Soviet Crimea on 6th June, 1942. With great force, the projectile smashed through the water's surface on the Severnaya Bay beyond the city and continued to plough through 30 metres of deep water. The target was a large ammunition store, which the Red Army had hidden under the seabed. The shell drilled down through the sand and the bedrock before breaking through a thick protective wall of reinforced concrete that the Russians had moulded around the underwater depot. A powerful quake spread as the Russian bombs and shells ignited and detonated. The warehouse exploded like a volcano sending thick black smoke across the peninsula.

The Germans cheered. For several months they had tried to destroy the ammunition depot, but because of its location beneath the seabed it had not been possible. Thanks to the Wehrmacht's latest pride and joy – Schwerer Gustav (Heavy Gustav) – it had finally been successful. And the German army had high hopes that the 1,350 kg heavy railway gun could play a decisive role in capturing Sevastopol.

The Germans' belief in Schwerer Gustav was well-founded. During World War I, large, powerful guns had secured the German army important breakthroughs. Not least Big Bertha: this 420-mm howitzer from the Krupp factory had impressed by reducing the heavy concrete fortifications around the Belgian city of Liège to ruins. Big Bertha proved to be less effective against more recent fortifications, but the gun's successes convinced the Germans that bigger was better and that the development of more powerful artillery was the road to military superiority. When the French in the 1930s created the so-called Maginot line – a 300-kilometre-long chain of 58 fortified steel and concrete bunkers – Hitler decided to visit the Krupp factory in March 1935. Here the German dictator asked its owner, Gustav Krupp von Bohlen und Halbach, if it were possible to make a gun that could penetrate through the Maginot line's concrete walls. Krupp answered with a cautious "yes" and immediately set up a team with physics professor Erich Müller at its head to design the desired gun. At the beginning of 1937, engineers and researchers completed their calculations, and Krupp could show the drawings to Hitler's military experts. The result was impressive. Krupp promised that projectiles fired from the super gun could punch holes through both reinforced steel and concrete.

Hitler approved the project enthusiastically and allocated 10 million Reichsmarks for production. The Führer, however, stressed that the gun had to be completed by spring 1940.

HITLER WAS GIVEN A GIANT GUN AS A GIFT

That would not be the case. No one had previously built such a large gun, and production at Krupp's factory in Essen became drawn out. It wasn't until the end of 1941 that the gun

ARTILLERY

GIANT GUNS THUNDER THROUGH 500 YEARS

1464

The **Dardanelles Gun** was moulded in the form of an older Ottoman cannon. With a calibre of 630 mm, it was five metres long and almost 17 tonnes. It was used for the last time against British ships in 1807 during the Anglo-Turkish war.

1586

Measured by its calibre of 890 mm, the **Tsar Cannon** is one of the world's largest. The Tsar measures 5.34 metres and weighs more than 39 tonnes. It has been displayed in several places across Moscow, including Red Square. There is no evidence that the cannon was ever used in war, although studies reveal it has been fired at least once.

The Tsar Cannon stands in Moscow's Red Square to defend the Kremlin area.

1857

Mallet's Mortar was designed for use in the Crimean War, but wasn't completed in time. The British weapon had a calibre of 914 mm, was 3.4 metres long and could fire a tonne of heavy shells to a distance of around 2.5 kilometres. The cannon, which is a mortar, was built in parts so that it could be transported more easily.

Shells from Mallet's Mortar flew for 23 seconds before they hit.

The Germans moved into the outskirts of Sevastopol after Schwerer Gustav's job was done, in early July 1942.

was ready for its final test run. The trial firing took place on the shooting range in Rügenwalde in present-day Poland, and both Hitler and his chief architect – later Armaments Minister – Albert Speer were present. Dressed in a long leather jacket against the January cold, Hitler was pleased to note how Schwerer Gustav effortlessly drilled through the test line's armour plate to fully fulfil the manufacturer's promise. Krupp, who acted as personal host, then solemnly delivered the gun to Hitler as Krupp's contribution to the war effort.

By this time, however, Schwerer Gustav was no longer needed at the Maginot line. Hitler's forces had cleverly marched around the defences, and by spring 1940 had subjugated the vast majority of Western Europe in a few weeks. Hitler therefore believed that the gun could instead be deployed on the Eastern Front, where the Wehrmacht was encountering strong resistance from the Russians. The city of Sevastopol, which the German dictator had dubbed an "unsinkable aircraft carrier", lay on the Crimean Peninsula in the south-west of Soviet Union. It was important for the Germans, partly because it lay on the road to the important oil sources in the Caucasus and the Middle East, and partly because the Black Sea fleet had a base in the city.

The Black Sea Fleet had become a growing problem for the army. In the summer and autumn of 1941, aircraft from the naval base attacked the German forces at their most vulnerable point – their fuel supplies. Most of the important oil for German ships, tanks and planes came from the oil fields outside Ploesti in Romania, and during Russia's first attack on the fields and the surrounding refineries on 13th July, 1941, 9,000 tonnes of oil went up in smoke.

Five days later, a new attack destroyed another 2,000 tonnes of

1914

German gun **Big Bertha** pounded concrete fortifications in Belgium to dust with 800 kg of heavy shells at the outbreak of World War I.

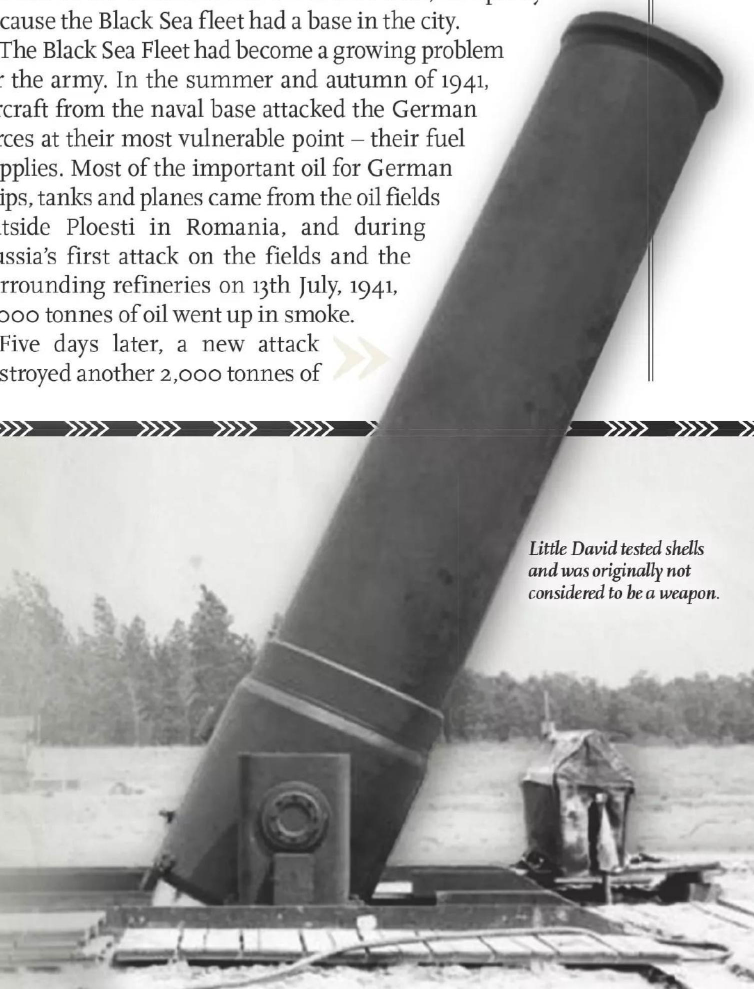
The German gun Big Bertha weighed 42 tonnes.

1920

The British also developed large guns during World War I. The **BL18** railway howitzer had a calibre of 18 inches (457.2 mm) and a range of almost 21 kilometres. The weapon was only completed in 1920, so never made it into combat. One of the five guns made was used as part of UK defences in WWII.

1941

With a calibre of 910 mm, the US gun **Little David** surpassed the German's Schwerer Gustav. The Americans used Little David to test fire aerial bombs, but considered using it during the planned invasion of Japan. Little David was, however, never used in war.


Little David tested shells and was originally not considered to be a weapon.

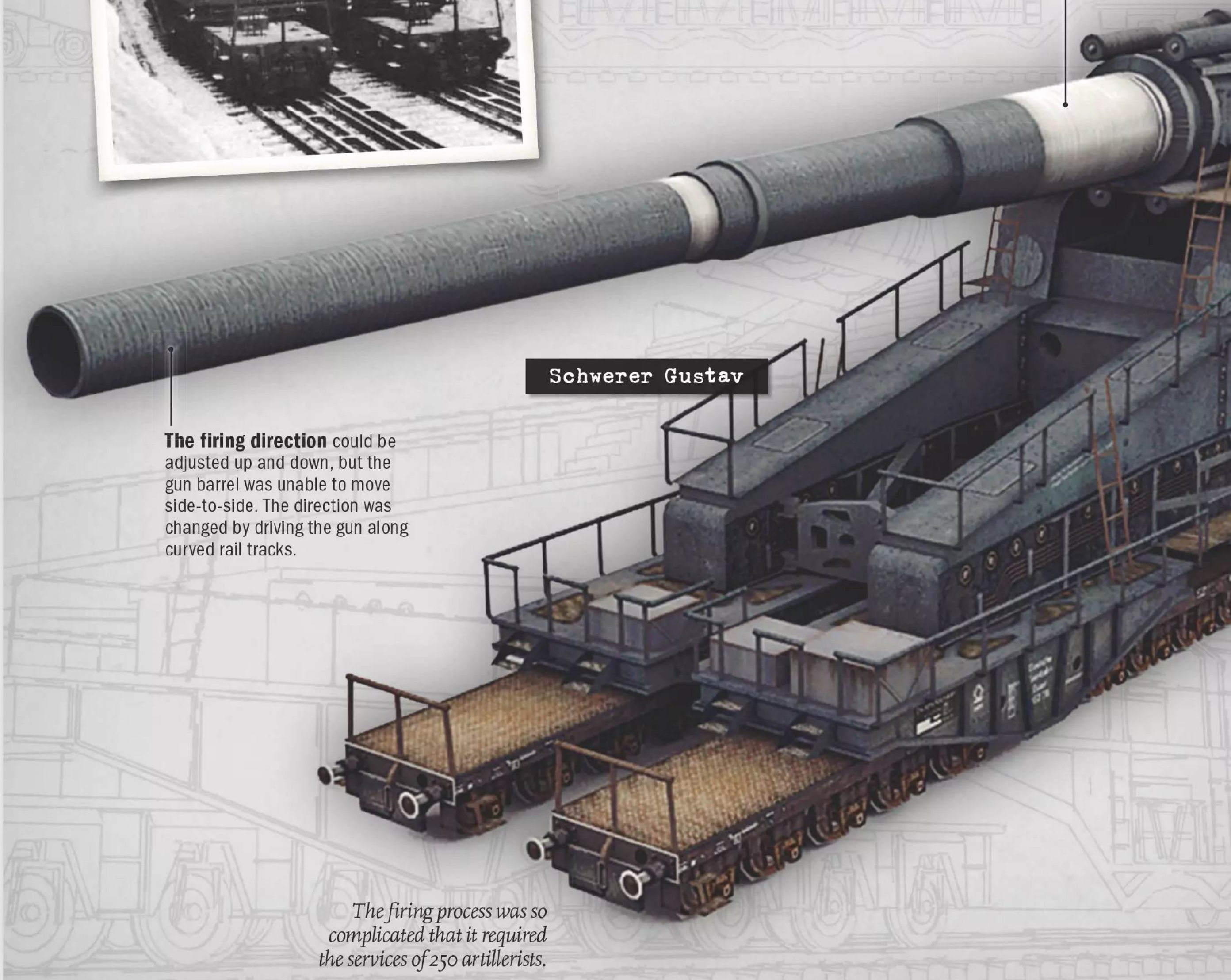
WEAPON

Gun only fired 14 shots a day

Before each shot, Schwerer Gustav required so many adjustments and fine tuning that the gun could only be fired a maximum of 14 times a day.

It took the Germans two months to transport Schwerer Gustav by train to Sevastopol.

The gun carriage weighed 400 tonnes and had to be separated into two parts during transport.



The firing direction could be adjusted up and down, but the gun barrel was unable to move side-to-side. The direction was changed by driving the gun along curved rail tracks.

The firing process was so complicated that it required the services of 250 artillerists.

oil. The amount of fuel lost would have fulfilled the needs of around 19,000 Tiger I tanks – a big loss for the Third Reich, which had only very limited fuel resources. Hitler saw only one option: to neuter Soviet forces in the region. A few days after the attack on 23rd July, 1941, the dictator issued a supplement to Führer Directive 33 stating that "the bulk of the infantry divisions will then occupy Ukraine, the Crimea, and the area of Central Russia up to the Don". On 12th August, he decreed that Army Group South must "occupy the Crimean Peninsula, which is particularly dangerous as an enemy air base against the Romanian oilfields".

RUSSIANS PROVIDED STIFF OPPOSITION

The task was assigned to Generaloberst (Colonel General) Ernst Erich von Manstein and the 11th Army. Von Manstein took over command on 17th September, 1941 and moved swiftly. On 1st November, the general had taken Simferopol, capital of Crimea, and it was followed by the fall of Kerch, another strategically important city, on 16th November. Now the Germans could tackle the port city of Sevastopol, which housed the Black Sea Fleet and the threat to the oil supplies.

But the city and the navy base were heavily fortified, and the German thrust was halted. The base was located on a promontory on the south-west tip of the Crimea, which made an attack from land extremely difficult. In addition to its natural defences, the Soviet fleet had secured itself with heavy artillery, which pointed at both land and sea. In addition, a hastily convened force of the city's citizens had reinforced the fortress around Sevastopol with three defensive belts consisting of anti-tank trenches, barbed wire, bunkers and mines. A German attempt to take the city on 17th December failed, and after the Russians were able to force the Germans back from Moscow the following month, Hitler became increasingly desperate. In April, he called von Manstein to his headquarters, Wolf's Lair in present-day Poland. Take Sevastopol no later than mid-August, the order sounded.

Von Manstein began his new offensive on 8th May, 1942 under good conditions. His 204,000-strong force was nearly twice the size of the Soviet defences, which numbered 106,000 under the command of General Ivan Petrov. There was also a disparity in the air forces: the Germans enjoyed massive support from VIII Air Corps and Air Fleet 4, which again was almost twice the size of the Soviet air force. Air superiority helped the Germans make a rapid advance during the first days of the offensive, but as the forces approached the city itself, von Manstein's men met massive resistance.

SUPERGUN WAS CAMOUFLAGED

The Germans shots bounced off like hailstones when they hit the Soviet bunkers, which were made of reinforced concrete. The attacks were also hampered by the fact that many defensive installations proved impossible to destroy because they were dug into the ground. By the end of May the advance had once again been halted.

Help was on its way, however. In February, as the siege of Sevastopol slipped into deadlock, army command deployed

FACTS

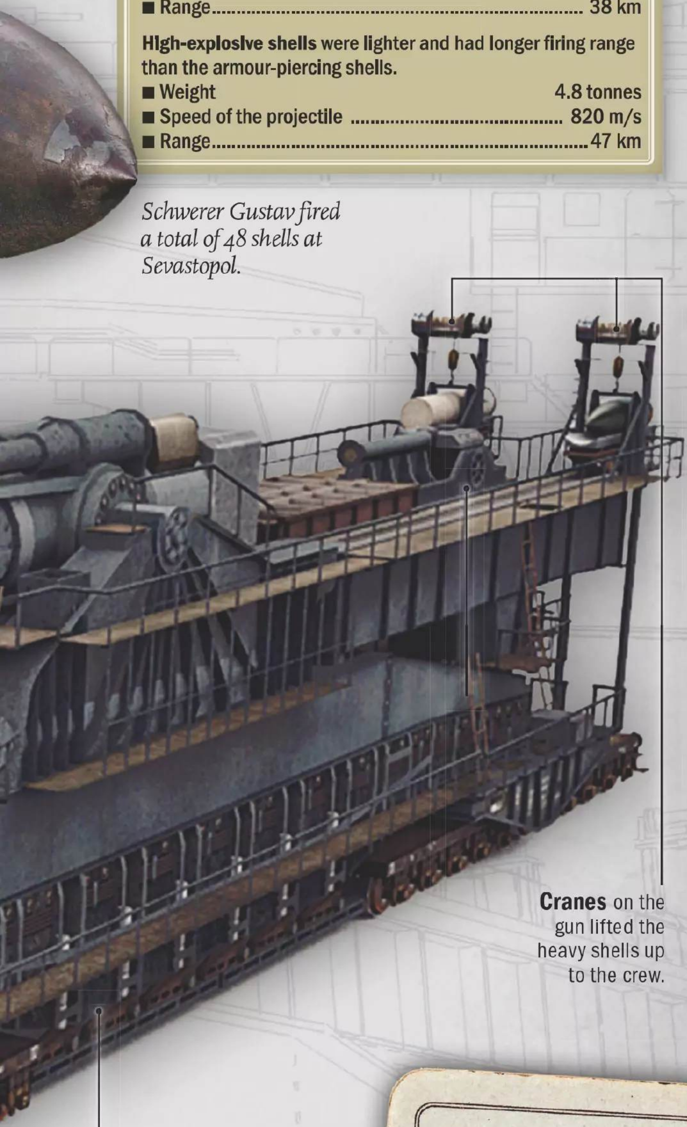
TWO TYPES OF SHELL

Armour-piercing shells were able to penetrate eight metres of steel concrete, one metre of steel or 32 metres of soil.

■ Weight	7.1 tonnes
■ Speed of the projectile	720 m/s
■ Range	38 km

High-explosive shells were lighter and had longer firing range than the armour-piercing shells.

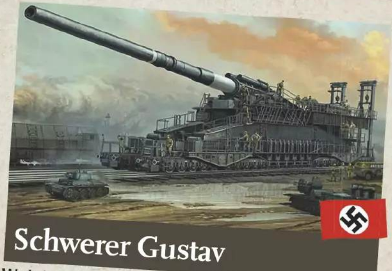
■ Weight	4.8 tonnes
■ Speed of the projectile	820 m/s
■ Range	47 km



Schwerer Gustav fired a total of 48 shells at Sevastopol.

Cranes on the gun lifted the heavy shells up to the crew.

It took **eight carriages** to carry the gun carriage when it was assembled and made operational. During transportation to the front, Schwerer Gustav was divided into five parts, carried across 28 wagons.



Schwerer Gustav

Weight	1,350 tonnes
Length	43 metres
Height	11.6 metres
Width	7.1 metres
Length of run	32.48 metres
Calibre	800 mm
Crew	500

Schwerer Gustav to the Crimea. The operation was particularly suited to the giant weapon. The 40-metre-long gun couldn't be transported in one piece, but had to be split into parts and shipped using no less than 28 railway wagons, which formed a train 1.2 kilometres long.

The army chose to place the gun in the city of Bakhchysarai outside Sevastopol, where engineers and soldiers were busy digging a big trench. The intersection, resembling a sunken road, would serve both as a base for the giant gun and provide cover against air and artillery. The area was camouflaged in the hope of fooling the enemy. Engineering troops also worked on an area a kilometre away in an attempt to fool the Soviet forces and divert attention from the actual base.

The Germans built two sets of railway tracks: one set for Schwerer Gustav and one for the 110-kg heavy crane, which was required to both assemble and disassemble the gun. The gun was only able to change its direction of fire by following the curved tracks.

It was one thing to construct the railways, however, but quite something else to assemble the 1,350-tonne steel monster.

Russian medal given to participants in the defence of Sevastopol.

GUSTAV DESTROYED EVERYTHING

About 2,000 men – craftsmen, infantry, anti-aircraft gunners and security police – were brought together to build Gustav. The entire process took around three weeks, but by early June Gustav was ready to fire on Sevastopol.

Von Manstein was excited. "It was a miracle of technical achievement", the general wrote in his memoirs. "The barrel must have been 90 feet long and the carriage as high as a two-storey house". On 2nd June, he launched another offensive against Sevastopol. The attack began with a massive bombing of the city, and three days later on 5th June at 05.35, Schwerer Gustav thundered for the first time. Coastal batteries were the gun's first target. The weapon fired its projectile at tremendous speed 12 kilometres into the air. One minute and 40 seconds later the shell crashed down on its target. After eight shots with the armour-piercing shells, the coastal batteries were in ruins.

The next day, Schwerer Gustav destroyed the underground ammunition store at the Severnaya Bay with nine armour-piercing shots. During the day, the giant gun pounded two more targets – fortified concrete positions that the Germans had dubbed Fort Stalin and Fort Molotov. But Schwerer Gustav had just begun. Over the following two weeks, the gun repeatedly rained its all-penetrating shells on Sevastopol's heavy fortifications. One by one, the concrete juggernauts evaporated into dust until the giant gun finally lay silent on 17th June. Over the space of 12 days, Schwerer Gustav had destroyed all its targets – either the defensive posts

It wasn't simply Sevastapol's forts that were destroyed – houses lay in ruins too after the German siege.

were crushed or so damaged that the Soviet crews abandoned them. The steel monster did with just 48 shells what 500,000 shells from other guns had not achieved earlier during the siege. The Germans were far from victory, however. The destruction of the forts did not lead to the Soviet troops' surrender. Stalin's forces were ready to defend Sevastopol by any means, and the long-standing siege of the city began to take its toll on the German soldiers.

"One lived only on cigarettes, cold coffee, tea and the sparse battle rations that were issued daily to those in the foremost lines. It was impossible to wash regularly or to shave", remembered Öbergefreiter (Senior Lance Corporal) Gottlob Bidermann later during the bombardment.

The Wehrmacht also met with other difficulties. Until 16th June, German aircraft controlled the airspace and bombed the city's port, storage facilities, hangars, barracks and supply depots with high explosive bombs. 1,800 sorties a day was common. But, by the end of June, the Luftwaffe was running out of both bombs and fuel, and the number of sorties fell by 40 percent. A quick victory at Sevastopol was needed.

Von Manstein decided to make a bold move. If his forces could cross the 600-metre-wide Severnaya Bay and overcome the last Soviet defences at Inkerman, a city five kilometres east of Sevastopol, they could move on into the city. The operation began shortly after midnight on 29th June. A fleet of 76 small ships sneaked across the narrow waters in the dead of night. The Germans took a huge risk – just one well-targeted salvo from one of the Soviet machine gun positions could have led to disastrous consequences for the light vessels. Luckily for von Manstein, the Soviet lookouts were too exhausted to discover the landing in time. By the time they smelled a rat, German infantry were already attacking the fortifications. After 45 minutes, the Germans reached the hills surrounding the landing point and moved further towards Sevastopol. After another six-day struggle, the Army finally defeated the city's defenders who surrendered on 5th July.

GUN DISAPPEARED WITHOUT A TRACE

The Germans suffered a loss of 35,866 dead and wounded during the siege while Petrov's coastal army was destroyed. The final battle alone took around 18,000 German and Russian lives, and when the city fell, the Wehrmacht claimed it had taken 95,000 Russian soldiers prisoner. However, the fighting wasn't just hard on the two armies – many of the city's 111,000 inhabitants died too.

Hitler appreciated von Manstein's efforts and promoted the colonel general to field marshal four days before the city fell. German troops celebrated the conquest during a victory parade in Sevastopol on 5th July, although a few scattered pockets of Russian troops continued to resist until 9th July.

A terrible fate now awaited Sevastopol. SS-Einsatzgruppe D began to systematically exterminate Jews and Soviet prisoners of war. The bodies were thrown into mass graves outside the city. Then the SS soldiers turned on civilians as they gassed them to death in special gas vans, known as "soul killers".

Following its efforts at Sevastopol, Schwerer Gustav's role was over. The steel monster was far too slow and difficult to move around to other fronts. The gun's fate is uncertain, but all indications suggest the weapon was sent back to Germany, where the Wehrmacht destroyed it at the end of the war.

PERSPECTIVE

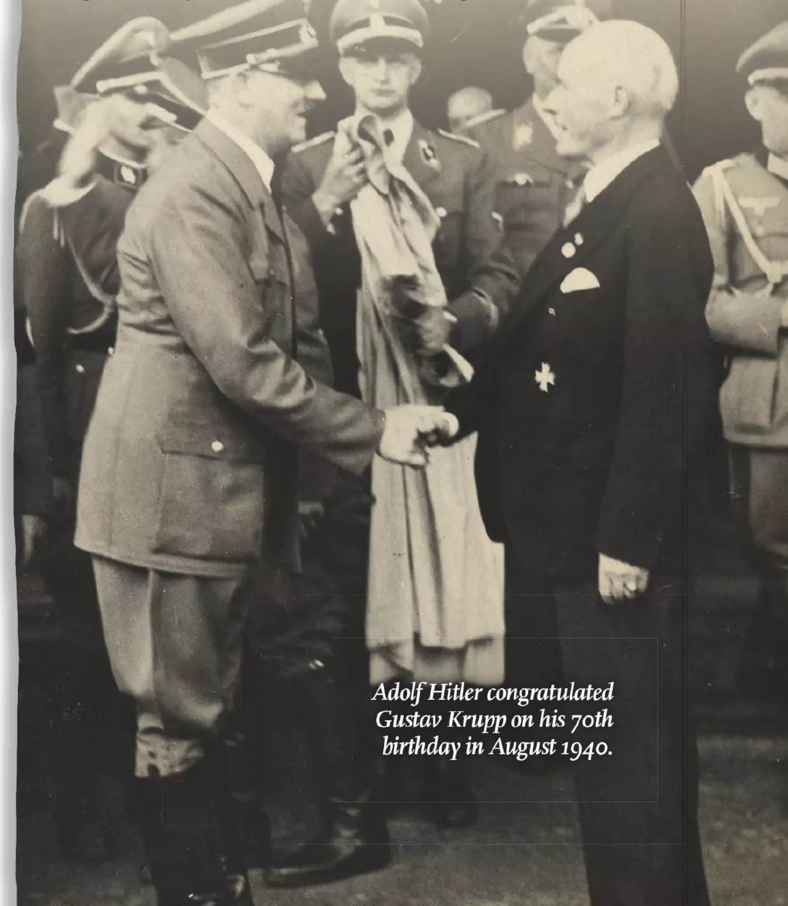
Industrialist persuaded by rebuilding

Industrialist Gustav Krupp was sceptical of Hitler, but changed his opinion when he heard about the Nazi leader's plans for rebuilding.

When Hitler was up for election in 1932, Gustav Krupp von Bohlen und Halbach – one of Germany's largest industrialists – didn't believe the man who would be Führer could provide the country with the stability it needed. Krupp changed his mind, however, when he heard of Hitler's plans to monumentally rebuild the nation. Almost overnight the industrialist became – as a friend later put it – a "super Nazi".

His about-turn paid off as Hitler's war preparation meant major orders and corresponding profits for his long-established family business, which specialised in steel and arms production. From 1933 to 1941 the value of his manufactured war equipment – including tanks, guns and ammunition – increased from **20,975,000** to **152,047,000** Reichsmarks. Production was cheap, as the workforce included concentration camp prisoners and PoWs who worked for free under miserable and slave-like conditions. A conservative estimate suggests around 100,000 people worked for Krupp under these conditions. Many starved or died from exhaustion.

The Krupp firm grew rapidly after the war and is today merged with Thyssen, another German steel giant.

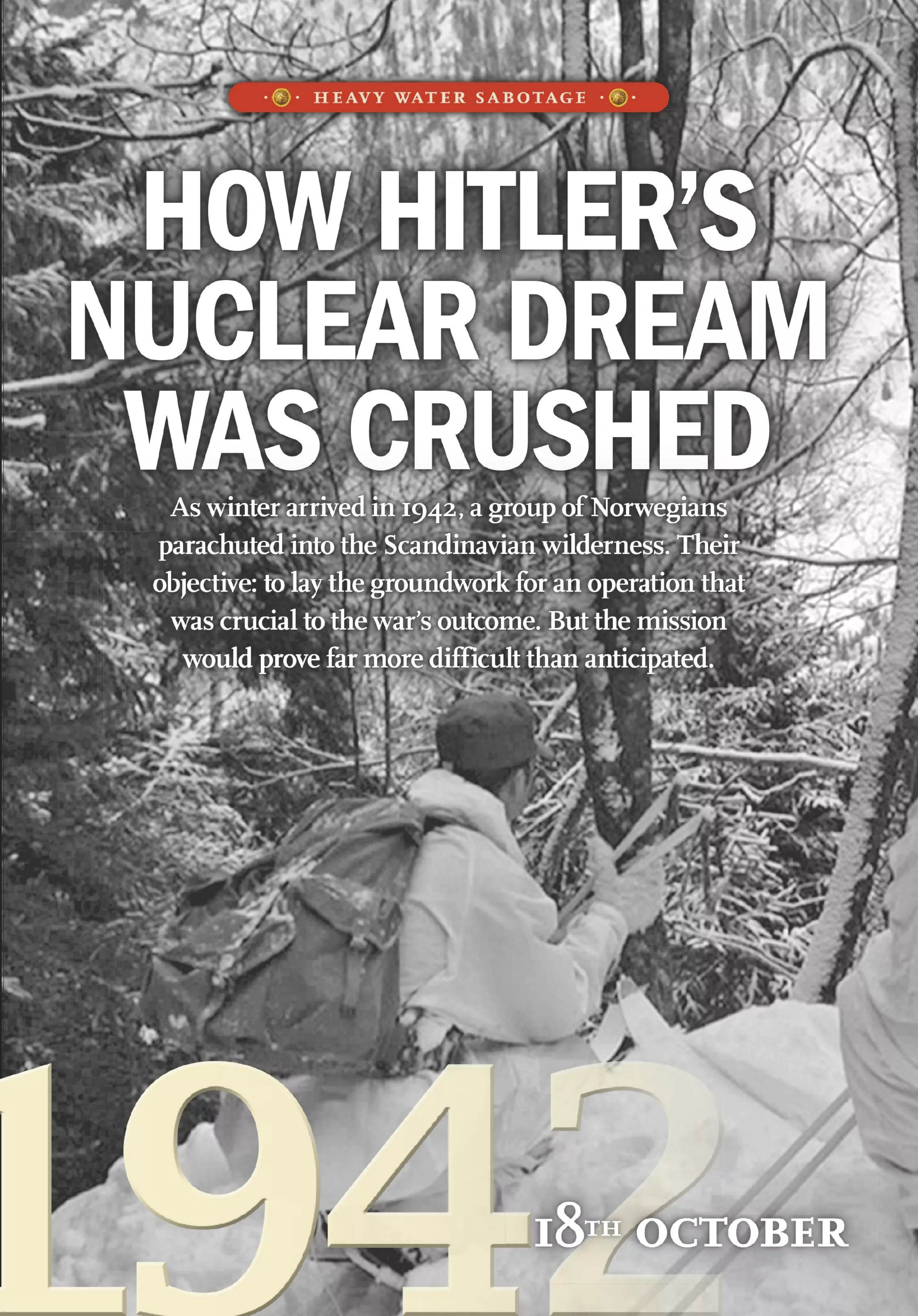


Adolf Hitler congratulated Gustav Krupp on his 70th birthday in August 1940.

HEAVY WATER SABOTAGE

HOW HITLER'S NUCLEAR DREAM WAS CRUSHED

As winter arrived in 1942, a group of Norwegians parachuted into the Scandinavian wilderness. Their objective: to lay the groundwork for an operation that was crucial to the war's outcome. But the mission would prove far more difficult than anticipated.



1942

18TH OCTOBER

Despite a huge German army presence, the Norwegian saboteurs found a way into the factory that no-one had considered.

Norway 1942

THE STAGE IS SET

Norway
Vemork

In 1938, German scientists discover nuclear fission, which can be used to create a doomsday weapon. But the process requires heavy water, which is only produced in sufficient quantities in one place in Europe: Vemork in Norway. The Allies must destroy the heavy water plant at Vemork at all costs.

Einar Skinnarland was an engineer at the German-controlled heavy water plant in Vemork and knew the place well. This was why the British picked him to spearhead a sabotage operation that would end the nightmarish possibility of Germany developing the world's ultimate weapon: the atomic bomb.

Skinnarland was selected because he had access to the factory and knew the area. He secretly travelled to Britain where he received ten days intensive instruction, including a single trial jump by parachute. A few days later Skinnarland was flown back to Telemark, but as the reality of his situation dawned, he became reluctant to jump and only steeled himself to parachute into the snowy expanse after the plane had spent 20 minutes circling the drop zone.

FACTS

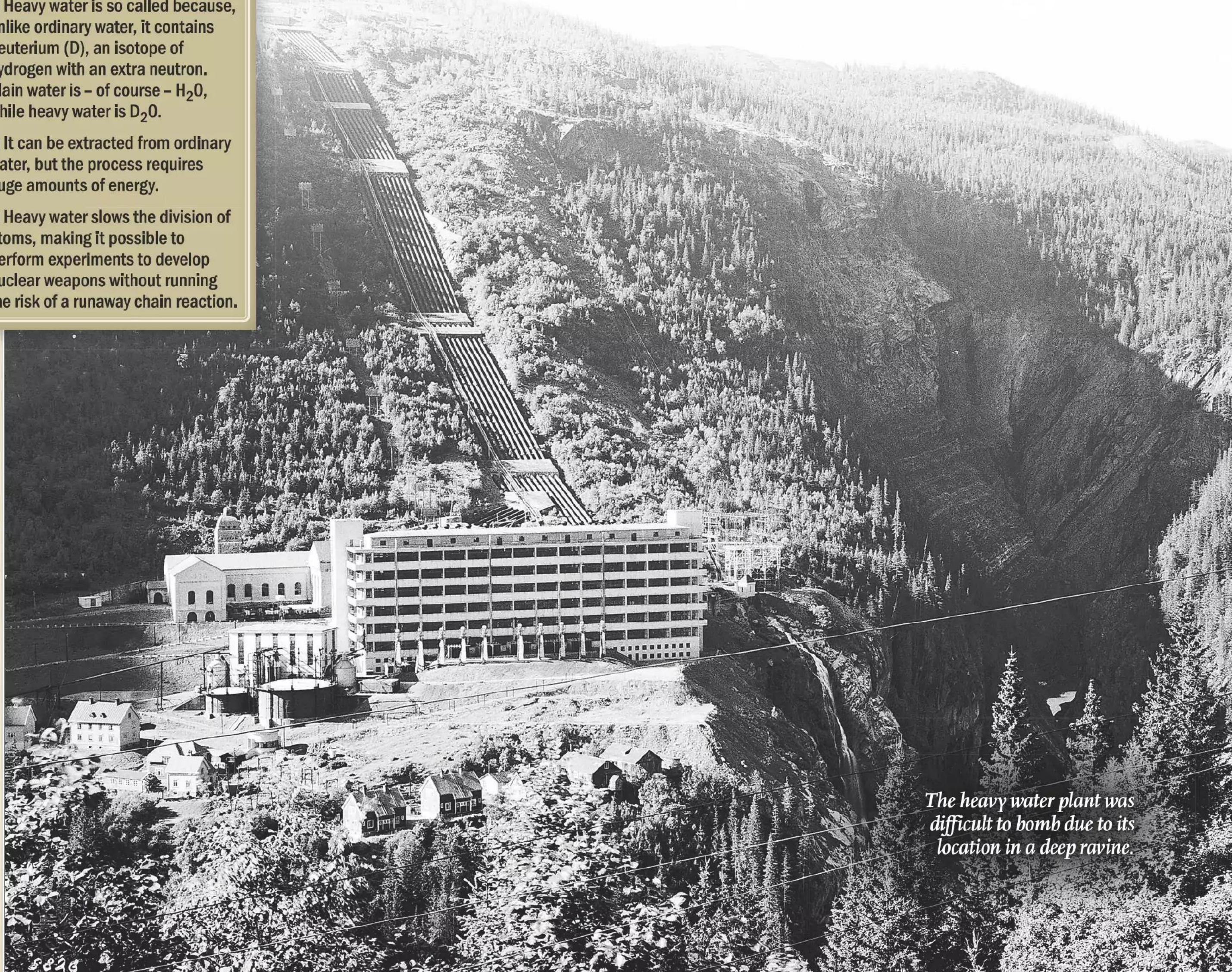
HEAVY WATER

- Heavy water is so called because, unlike ordinary water, it contains deuterium (D), an isotope of hydrogen with an extra neutron. Plain water is – of course – H_2O, while heavy water is D_2O.
- It can be extracted from ordinary water, but the process requires huge amounts of energy.
- Heavy water slows the division of atoms, making it possible to perform experiments to develop nuclear weapons without running the risk of a runaway chain reaction.

SPY SENT DAILY REPORTS

After returning to the factory, Skinnarland resumed his work while transmitting information to Britain on an almost-daily basis. His reports were accurate but kept short to prevent the local German signal corps from tracking the radio's location.

From early in the war both British Prime Minister Winston Churchill and US President Franklin D Roosevelt were aware



The heavy water plant was difficult to bomb due to its location in a deep ravine.

the Germans might be trying to develop a superweapon, and that heavy water would play a crucial role in its development. By December 1938, German scientists Otto Hahn and Fritz Strassmann had already managed to split uranium atoms for the first time by bombarding them with neutrons. This nuclear reaction could release tremendous energy, which intelligence reports revealed could be used to create a bomb significantly more powerful than anything previously known.

At the same time, both Allied leaders had agreed that the civilian population must not be made aware of a possible German superweapon that could destroy entire cities – it would only lead to panic. As a result, everything related to the operation was given codenames, with heavy water being dubbed 'Lurgan', after the Northern Irish town.

SUPPLIES GREW ONE DROP AT A TIME

Heavy water slows down the nuclear reaction to make it possible to experiment with the development of a weapon without generating a runaway chain reaction. It became clear to the Allies that there was only one practical location in all Europe where the Germans could produce Lurgan in sufficient quantities: the plant at Vemork in occupied Norway.

The factory, located just outside Rjukan in Telemark county, was the world's largest hydroelectric plant when it was built in 1911. Owner Norsk Hydro primarily manufactured fertiliser, with heavy water as a by-product. Heavy water production requires enormous amounts of energy, but that wasn't a problem thanks to Vemork's abundant hydroelectricity supply. Drop by drop, the German stocks of heavy water grew.

One of the men behind the factory's construction was Norwegian professor Leif Tronstad. He was one of a select few who knew what heavy water could be used for, and when the Germans announced they wished to speed up production ten-fold in 1941, he tried to slow down or sabotage their efforts. He even contaminated the heavy water with fish oil, but after the Germans grew suspicious, Tronstad fled to Britain.

He became an extremely important asset for the Special Operations Executive (SOE), Britain's secret army designed to wage war through non-military means. Its responsibilities included the organisation of espionage and sabotage operations behind German lines. Many members came from occupied territories – including entire Norwegian units.

When Tronstad's intelligence reached Churchill and Roosevelt, it became clear that the production and supply of heavy water had to be destroyed. But the Allies faced a strategic nightmare. SOE had no operatives in Telemark, and the Norwegian resistance movement had yet to form. The factory was situated on a steep mountainside in a narrow ravine, which could only be accessed via a road that wound its way up from a ferry berth on the shores of Lake Tinn. The ferry provided the only way into or out of the narrow valley.

RAVINE WAS TOO NARROW FOR PARACHUTES

Parachuting into the valley wasn't an option – it was too narrow and deep. For the same reason, a precision-bombing raid wasn't viable, either – especially as the Germans had taken extra precautions by stringing three large steel chains across the valley to prevent bombers from getting close.

The British considered bombing a large dam on Møsvatn lake above Vemork, but it was vetoed by the Norwegian government-in-exile because of the loss of life and the need for Norway to maintain its fertiliser production facility.

1918-2002

NAME **EINAR SKINNARLAND**

TITLE ENGINEER

Mole on the ground led the way

Einar Skinnarland had lived almost all his life in Rjukan and knew the area inside out. He also knew about the plant's interior, knowledge that was worth its weight in gold to the saboteurs. Later, Skinnarland was awarded the Distinguished Conduct Medal (DCM).

- **Worked as an engineer at the plant.**
- **Emigrated to Canada.**

1918-2010

NAME **JENS-ANTON POULSSON**

TITLE SECOND LIEUTENANT

Officer operated out of Britain

After the Norwegians surrendered in 1940, army officer Jens-Anton Poulsson fled to Britain. There he joined NIC1 (Norwegian Independent Company 1), staffed by Norwegian volunteers. Poulsson led the first sabotage group that landed in October 1942.

- **Played himself in movies.**
- **Led UN forces after the war.**

1919-2018

NAME **JOACHIM RØNNEBERG**

TITLE OFFICER AND JOURNALIST

Reporter led second group

Joachim Rønneberg escaped to Britain on a cutter in 1941 to join NIC1. He later commanded the second group, which landed in February 1943. During the campaign, Rønneberg knew nothing about heavy water and only realised the mission's importance when he saw the nuclear bombs drop on Japan.

- **Later worked for Norway's NRK.**
- **Awarded the Distinguished Service Order.**

Instead, a sabotage operation was mooted, and Einar Skinnarland became the first key operative. His intelligence provided SOE with a decent overview of German troop deployments in the area. The factory was tightly guarded, and the Germans were planning to lay landmines around the huge pipes that fed water into the hydroelectric power plant to prevent potential saboteurs from approaching.

SABOTEURS WERE TRAINED IN SCOTLAND

Meanwhile, a group of five young Norwegians were being trained at a secret camp in Scotland. Three had

Saboteurs landed in frozen hell

The steep mountain slopes made it impossible to land the saboteurs near the plant at Vemork. The solution was to drop them some distance away, so the German occupying forces had no idea they were there.

NORWAY
VEMORK
OSLO

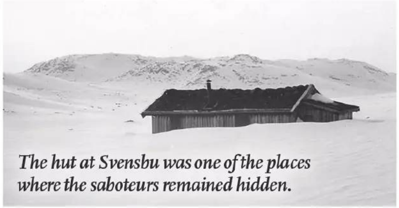
Hydroelectric power station was difficult to reach
Vemork was surrounded by mountains and lakes, making it virtually inaccessible – but the saboteurs were able to exploit their vast local knowledge to gain access.

1 Landing goes awry

18th October 1942: the first group is dropped by parachute, but the Norwegians land around 15 km from the planned landing site.

2 Reindeer supply much-needed meat

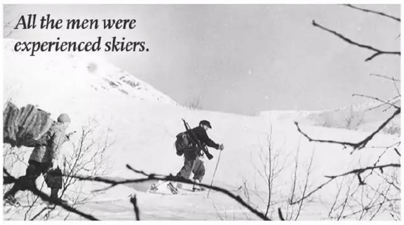
Winter 1942-43: The men are forced to hide in the wilderness. During the winter of 1942-43 they shelter in mountain huts and survive by eating what they can, including passing reindeer.



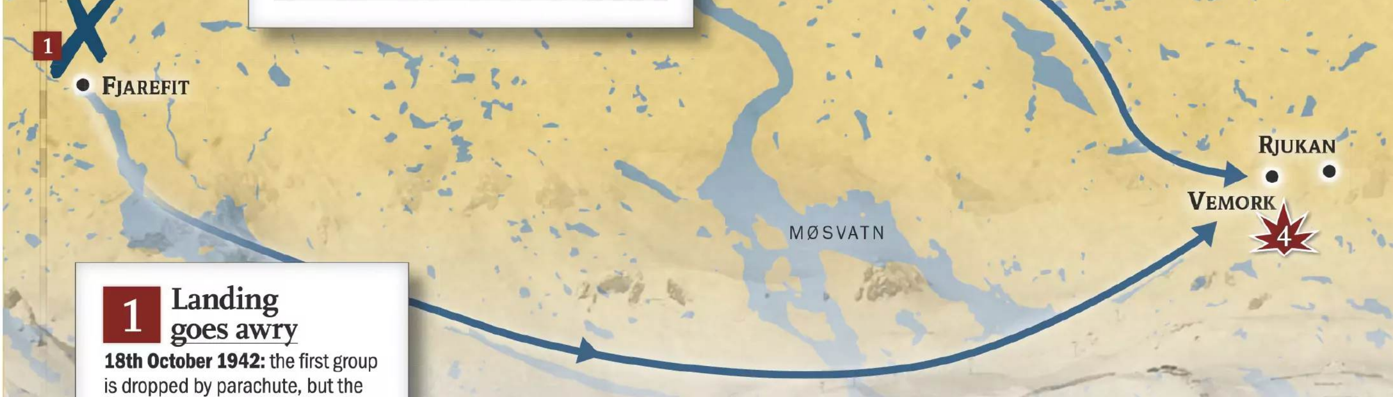
The hut at Svensbu was one of the places where the saboteurs remained hidden.

3 Second group makes contact

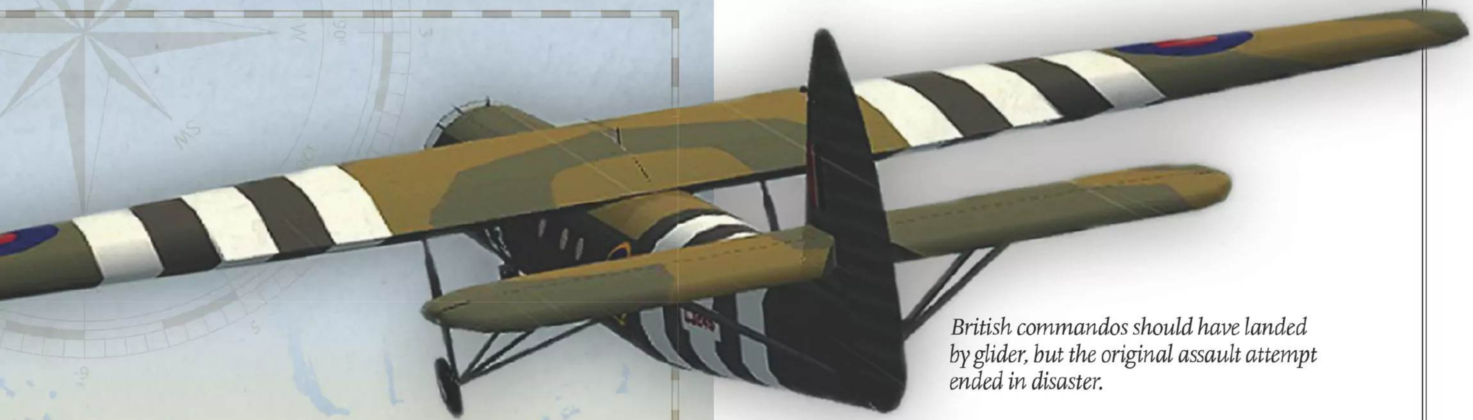
17th February 1943: Another six men parachute in. After several days of searching on the frozen Hardanger Plateau, the second group finally makes contact with the four saboteurs already in the area.



All the men were experienced skiers.



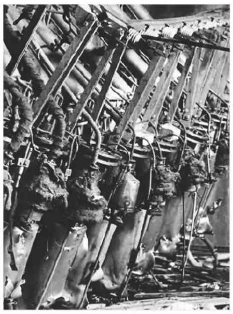
The men were forced to carry heavy equipment in temperatures as low as minus 30° C.



British commandos should have landed by glider, but the original assault attempt ended in disaster.

4 Plant is blown up

27th February 1943: Thanks to Einar Skinnarland's inside knowledge, the saboteurs succeed in gaining entry to the plant, and blow up the core components needed to produce heavy water. All 10 saboteurs escape the scene.



The operation destroyed the heavy water containers.

5 Ferry is sunk

20th February 1944: After the Germans rebuild the facility, they plan to transport the production equipment and heavy water supplies to Germany. Both are aboard a ferry, which is sunk by a bomb.

5
MÆL
TINNSJØ

grown up in Rjukan, and knew the high mountains around the town well, having spent their entire lives either walking them in summer or skiing them in winter.

The idea was to drop the group into the snowy terrain by parachute, after which they'd prepare for a future British operation. The training was gruelling. They navigated by maps and compass in the Highlands, learning to survive outdoors, deal with explosives, use codes and forge papers. they also learned to kill without their victims making a sound.

Unfortunately, one of the group injured themselves during training, so only four Norwegians jumped out of a British bomber on the night of 18th October 1942: Jens-Anton Poulsson, Knut Haugland, Claus Helberg and Arne Kjelstrup. Group leader Poulsson was a Norwegian army officer.

Six containers of equipment and supplies were also dropped over the deserted – and exposed – *Hardangervidda* (Hardanger Plateau). It was only on landing that Poulsson announced the purpose of their mission: to prepare the way for a British attack on the Vemork factory. But even Poulsson had no idea what heavy water could be used for; only that the Germans' stocks must be destroyed.

The following weeks were challenging. The group had landed around 15 kilometres west of their planned drop zone, and in addition to themselves and their heavy 30-kilogramme backpacks, they had to transport 250 kilogrammes of equipment. Three days later, the first snowstorm of winter arrived.

"Because the snow was wet, the ground wasn't frozen, the streams and lakes were open [ice-free], it took us one hell of a long time with all that equipment," Poulsson recalled.

At night they found shelter by breaking into deserted mountain huts scattered across the area, but their food supplies started to run low. One day, however, the group discovered a stray sheep and two lambs that had fallen into a ravine. They feasted for days.

With great difficulty they established radio contact with SOE back in London, and gradually moved close enough to Rjukan to be able to make tentative contact with some of the Norwegians working at the factory. They discovered the

Einar Skinnarland knew enough about the factory to provide the saboteurs with detailed plans for the plant.

Germans had laid booby traps and tripwires, added searchlights to the plant's roof and equipped German guards with machine guns. They also learned the German commander-in-chief in Norway, General von Falkenhorst, had visited the factory and warned of a British attack.

Pilots were confused by lakes

While the group laid the groundwork, back in Britain 34 British commandos from the 1st Airborne Division prepared for Operation Freshman, the codename for the assault.

On the Hardanger Plateau, the Norwegian group was ready to greet them. They had established a landing site on a frozen lake, for the bold plan was to land all 34 men in two gliders. Two Halifax bombers would tow the gliders across the North Sea and over southern Norway before releasing them to silently glide over Telemark and land without the Germans detecting them. On 19th November 1942, the 34 soldiers boarded the two gliders. They were crammed in, but managed to enter the airspace above the plateau without incident.

However, the tall mountain's many lakes confused the two bomber pilots, who decided to turn back. Unfortunately, both became disoriented in the dark winter night. One bomber crashed into a mountain, taking its glider with it. The other bomber made it back, but without its glider. The tow rope had frozen and snapped and the second glider, released at the wrong time, also crashed. The few survivors were captured by the Germans, interrogated and shot. The action's complete failure was compounded by the fact that the Germans now knew the factory was an active target.

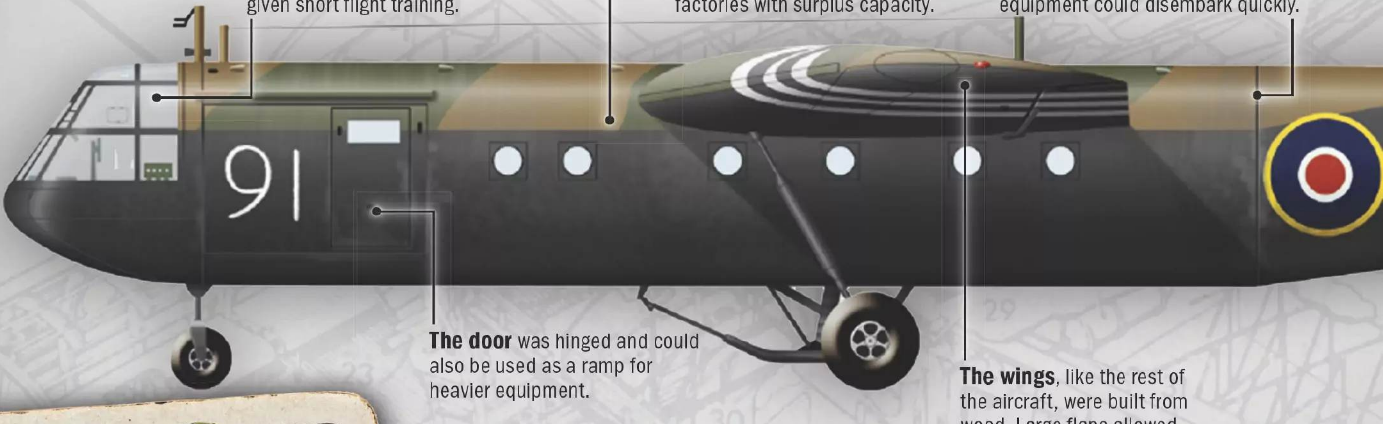
The catastrophe left a deep impression on both the British and the small group on the mountain. "Preserve your safety"

GLIDER

Disposable aircraft landed troops

The Airspeed Horsa was built by furniture factories and used to land troops. The aircraft was quick and easy to construct because it only needed to be used once.

On 19th November 1942, the British attempted to land commandos to sabotage the Vemork plant using two gliders. The landing failed when both aircraft crashed, but on many other occasions during the war, the simple, lightweight Airspeed Horsa glider proved particularly well-suited to ferrying troops into hostile war zones.



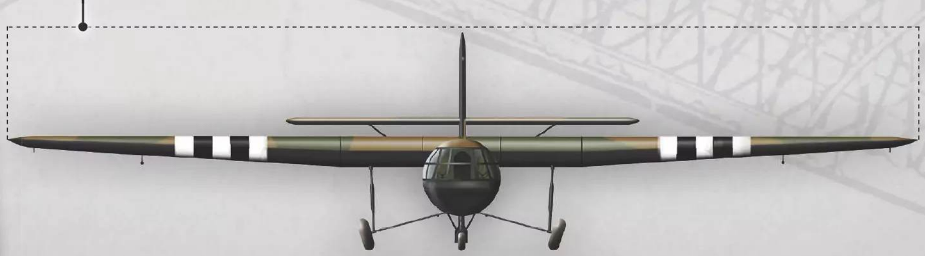
The cockpit housed two pilots. The pilots were often soldiers given short flight training.

The hull was completely wooden. The aircraft were built by furniture factories with surplus capacity.

The joint at the rear end of the main section could be broken so men and equipment could disembark quickly.

The door was hinged and could also be used as a ramp for heavier equipment.

The wings, like the rest of the aircraft, were built from wood. Large flaps allowed for a steep landing.



Overall wingspan
26.8 metres

Airspeed Horsa

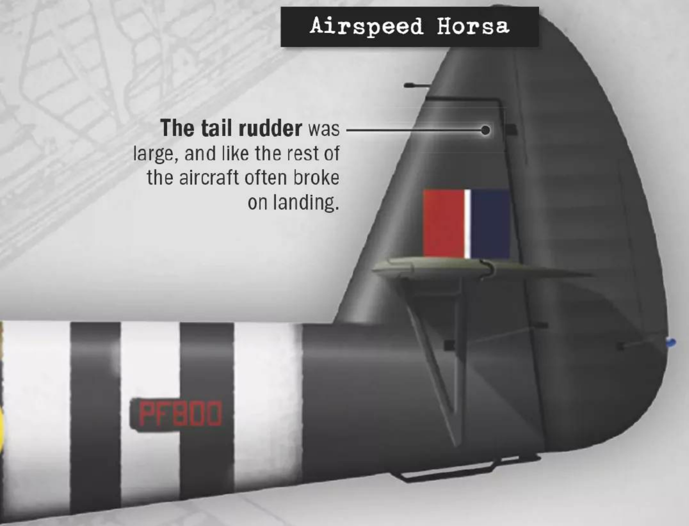
Length	20.4 metres
Wingspan	26.8 metres
Height	5.9 metres
Weight (when empty)	3.8 tonnes
Top speed (being towed)	242 km/h
Top speed (gliding)	160 km/h
Crew	2
Capacity	Up to 25 soldiers

was the message from London, which ended with a note of hope: “Keep up your hearts. We will do the job yet.”

At this point, the four Norwegians suggested that they mount an assault. Over time, this evolved into a new plan. Another group of young Norwegians were trained by SOE as the original four continued to hide out in the remote mountains. They found a cabin not marked on the maps where there was a store of firewood. But food was once again scarce, and all four were afflicted by fever and diarrhoea. They kept up morale by recounting tales from their childhood, and shortly before Christmas a herd of reindeer appeared in the area. It would be their salvation: “We ate everything except the balls and the hooves.” They even devoured the reindeers’ half-digested stomach content – the moss inside contained vital vitamins.

Meanwhile, back in Britain, six Norwegians had been picked to sabotage the factory together with the four on the mountain: their names were Joachim Rønneberg, Knut Haukelid, Hans Storhaug, Birger Strømsheim, Fredrik Kayser and Kasper Idland. Part of the training took place in a mock-up of the heavy water plant, which had been built with Norwegian help.

The British pilots struggled to get their bearings in the unfamiliar terrain.



Airspeed Horsa

The tail rudder was large, and like the rest of the aircraft often broke on landing.

Both pilots had their own steering column but little in the way of other controls.

The soldiers sat on small seats along the walls. The aircraft could also carry equipment like motorcycles.

EXTREME WINTER BIT HARD

The plan had been to take advantage of the quiet Christmas period to launch the operation, but it had to be postponed, and it wasn’t until mid-February that the six Norwegians could land on the Hardanger Plateau, where their countrymen had been forced to wait in the desolation and cold. The winter of 1942-43 was extremely hard, and on many days the temperature didn’t rise above minus 30° C in the frozen tundra.

The two groups spent several days searching for each other before they finally met up and established their base in a new cabin. This was located just five kilometres from the factory, but safely high up in the mountains. The Norwegians knew the Germans regarded the plateau as an ice-cold, inhospitable wasteland, and that their lack of experience of living in such a hostile terrain led them to believe it would be impossible for anyone to survive there.

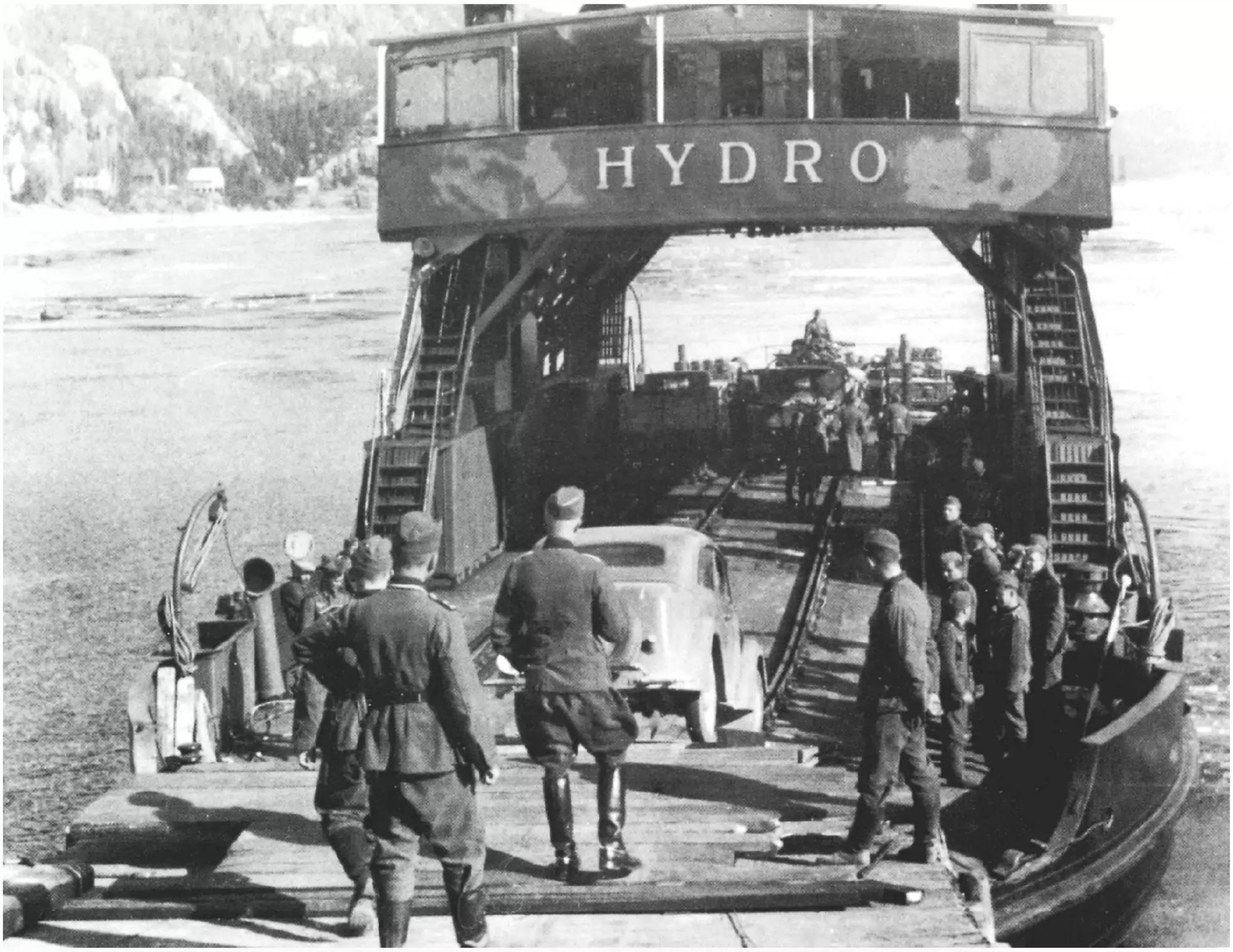
The group blacked out their windows and spent the following days reconnoitring. They spent their evenings discussing the best way of entering the factory and how they could escape afterwards. Claus Helberg outlined a new option: just below the factory, the river ran through a deep canyon, but from his reconnaissance he knew there was one place where you could easily climb up the ravine. That possibility had not been considered by the Germans, he argued. His plan was adopted after a vote.

On 27th February 1943 at 20.00 the action – dubbed Operation Gunnerside – commenced. The men checked their equipment and codes one last time and divided into two groups. They were in British uniforms, so the Germans would believe it was a British raid. If anyone got caught, they were ordered to commit suicide using poison. The weather was cloudy and mild – so mild in fact, that the snow was wet and slippery.

The Norwegians glided through the gorge on skis towards the plant. The climb from the ravine was easier than they’d thought, but the men were still dripping with sweat as they crept towards the factory. A deep hum from the turbines filled the air. Close to the plant, the saboteurs sat, waiting for the change of guard they knew would happen at midnight. New guards would arrive on the suspension bridge, which – aside from a railway track – offered the only way into the premises.

“When we were sitting there just waiting it was curious because it felt more or less like we were on a short rest during a training exercise in Scotland”, recalled Ronneberg.

While one team stood guard outside, the other cut through the chain securing the factory gates. The men broke into a basement, and thanks to their insider knowledge, entered a narrow cable shaft that led right into the room where the heavy water containers stood. They crawled on all fours through the tunnel. Here they disarmed the sole



Although the Hydro *ferry was well guarded by the Germans, the Norwegian saboteurs managed to sneak aboard and plant a bomb the evening before departure. The timer was extremely accurate, ensuring the bomb exploded at Lake Tinn's deepest point.*

guard, who shook like a leaf. The Norwegians then placed their explosive charges on each storage cylinder.

GUARD HAD LOST HIS GLASSES

As the men prepared to light the fuses, the guard suddenly pleaded with them to help find his glasses. "They are impossible to get in Norway these days", he told them. Surprisingly, the Norwegian saboteurs paused to help him locate them. Suddenly there was the sound of steps and a second person appeared, but it was only a Norwegian janitor.

The fuses were lit, the civilians ordered to run upstairs and then the saboteurs sprinted from the site. Just 20 metres away they heard the muffled sound of the explosions. The sound was almost lost in the general hum of the factory, but the explosives had done their job: 1,500 litres of heavy water were draining away.

It took a while before the alarm was raised, by which time all ten Norwegians were back in the ravine where no one dreamed of looking for them. The sirens howled over and over, and a stream of cars and lorries started to arrive. At a safe distance from the factory, the men crawled up from the gorge, after which they laboriously climbed up the steep mountain slopes. At 05.00 they finally reached the top and after a short break, travelled back to the cabin. Luck was with them – just after getting back a snowstorm blew up and drifting snow quickly covered their tracks.

After the war, a barrel was recovered and analysed, which confirmed it held heavy water.

Over the following days, the Germans launched a manhunt. They were convinced that "British gangsters" were behind the act of sabotage. Rumours spread that there were 2,000 Britons in the mountains around the town. An entire division hunted for them, but they found no one – although burned many mountain cabins.

The saboteurs split up. Five headed to neutral Sweden, 400 kilometres to the east. They tried to avoid inhabited areas as much as possible and reached their destination after 15 days. But the journey was hard. They had to sleep in the snow on several nights, while the straps from their backpacks bit deeper and deeper into their sore shoulders as they trekked on.

Several months later, the Germans resumed production of heavy water at the factory in Vemork, employing a new, more efficient technology.

This time, however, the Allies decided to simply bomb the factory, and on 16th November 1943 no fewer than 300 US-led bombers were sent to Norway. 162 of them participated in the attack, but despite dropping over 900 bombs, only 18 hit the factory and just one container of heavy water was destroyed. The cost was 22 innocent Norwegian lives. The Norwegian government-in-exile hadn't been consulted about the largely unsuccessful raid and were furious. The attempt, however, made such an impression on the Germans that in January 1944 they decided to dismantle the entire plant and move production to Germany. As before, the Allies were promptly informed of these developments, because several of the factory's Norwegian employees were now connected to the resistance movement, which had grown significantly.

CHURCHILL GAVE THE MATTER TOP PRIORITY

In Britain there was no hesitation: the plan to build a super weapon had to be foiled, even if it had serious, even fatal, consequences for the civilian population. Churchill became personally involved, and his message was clear: destroying the German supply of heavy water was their top priority.

But time was running out. The Germans had already started to dismantle the plant when Knut Haukelid – who'd remained in the area – was ordered to organise an attack. Thanks to intelligence from the factory staff, it was clear the Germans intended to transport the heavy water in 39 large drums via rail.

Haukelid added Rolf Sorlie, assistant engineer at the factory, to his group, which now tried to devise the best possible plan. The railway only ran a few kilometres before ending at the ferry that crossed Lake Tinn. It was clear that the cargo would be most vulnerable during the ferry crossing and was where the transport could be sabotaged.

The Norwegian responsible for the factory's transportation was involved in the plans and arranged the schedule so that the trucks would be on loaded on to the *Hydro,* the steam-powered railway ferry, on Sunday, 20th February. He chose a Sunday for two reasons: one, there was just one ferry crossing that day, and two, there would be fewer passengers onboard.

The next problem was how to construct a timed bomb. Haukelid knew a lot about explosives in general but had never worked on one involving a timer. It led to many hectic hours in a workshop before he was able to get one working using alarms clocks and electric detonators.

The evening before the transport, three of the group drove to the ferry point in Mael. They went aboard quietly, as if they were regular crew. And luck was with them. The German guards were sitting playing cards. One man kept the ship's Norwegian crew chatting while Haukelid and Sorlie sneaked into the bottom of the ferry. Here they placed 8.4 kilogrammes of explosives in a well-hidden spot. The alarm clock was set to detonate at 10.45.

Haukelid was a nervous man on Sunday morning. But his device worked – it detonated just as the *Hydro* sailed over the deepest part of Lake Tinn. The ferry quickly tipped on her side, and three minutes later was heading to the bottom of the lake, 300 metres down. It took 14 Norwegians, four Germans and almost all the German stock of heavy water to the depths with it. Fishermen and farmers who came to the rescue managed to save 19 passengers.

The Germans dared not confess to Berlin that they'd been sabotaged, so concocted a story that the ferry had exploded due to an accident. Production was never resumed, and Hitler never got his atomic bomb.

Nazis never developed the atomic bomb

German scientists worked for years to build a nuclear bomb that could determine the war. But the Allies had the means to win the race.

During World War II, both physicists and politicians were aware that nuclear fission was possible. It had the potential to release immense amounts of energy that could be used in a doomsday weapon with an unprecedented explosive force.

In Germany, several groups worked to develop such a weapon. But the project was never given top priority, as the Nazi leadership focused on other schemes, including the V-2 rocket. At the same time, German research was handicapped after many Jewish scientists, including Albert Einstein, were forced into exile or sent to concentration camps.

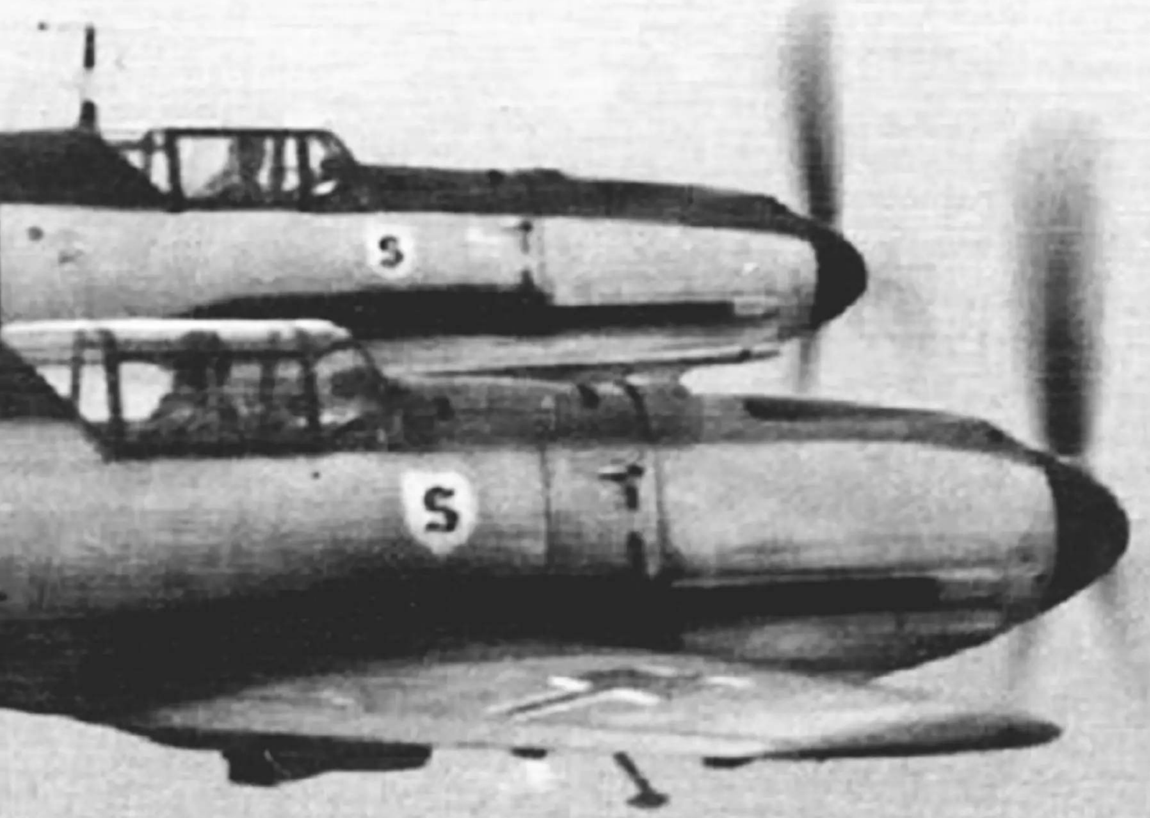
Once it proved impossible to obtain heavy water in sufficient quantities from the Norwegian factory, the development of an atomic weapon was set aside.

After the sabotage operation, the Allies tried to bomb the factory with little success.

The Battle of Britain in 1940 was a serious defeat for the Luftwaffe, but Messerschmitt pilots scored victory after victory on the Eastern Front.

1942

10TH DECEMBER

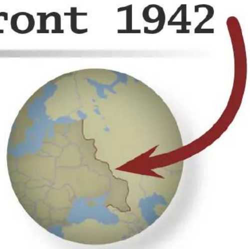


LUFTWAFFE

FIGHTER PILOTS SPREAD DEATH IN THE EAST

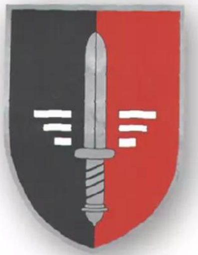
Jagdgeschwader 52 was the most successful fighter wing in history. With deadly efficiency, the pilots destroyed over 10,000 Soviet aircraft before Stalin could see them off. Even then, it took huge numbers of Soviet aircraft to overcome the Luftwaffe pilots' quality and experience.

Eastern Front 1942



THE STAGE IS SET

In all the major battles on the Eastern Front, the Luftwaffe provides crucial air support to the Blitzkrieg's panzer armies. Stalin's inadequate aircraft and poorly trained pilots are no match for Germany's ace flyers, but the Soviets just keep sending men and planes to the front in ever-greater numbers.



Jagdgeschwader 52's shield-shaped crest has a sword with wings.

On the tenth of December 1942, Jagdgeschwader 52 (JG 52) fighter wing's tally of victories in combat reached 4,000. The current crop of kills were being harvested near Stalingrad, where JG 52 was supporting the 4th Panzer Army's push for the Caucasus oil fields. The tally that day included all the wing's successes since the start of the war.

The count had begun three years earlier when Luftwaffe pilot Paul Gutbrod was conducting a routine patrol flight in his Messerschmitt Bf 109. Suddenly, a Mureaux aircraft appeared on the horizon. The lone French reconnaissance plane was circling a bridge across the Rhine, when Gutbrod banked his Messerschmitt towards it. The French pilot turned the Mureaux west, but he was too late: Gutbrod caught the slower machine and destroyed it with a burst of gunfire.

The reconnaissance plane crashed to the ground and Gutbrod returned to a hero's reception at Böblingen air base. The Luftwaffe had won its first victory on the Western Front and Gutbrod was rewarded with an Iron Cross (2nd class).

EASTERN FRONT OFFERED EASY PREY

The brief dogfight on 6th September 1939 was JG 52's first victory. Reichsmarschall Hermann Göring, the supreme commander of the Luftwaffe, had spent recent years overseeing a vigorous reconstruction of the German air force, and in 1939, JG 52 was one of a total of nine fighter wings, each consisting of well over 100 aircraft and

> **"One squadron shot down 93 aircraft in two weeks"**

JG 52 switched bases over 400 times on the Eastern Front. Fields were quickly transformed into airfields with runways and barracks then abandoned again, often after a few days.

staffed with well-motivated and highly trained pilots. Although many of the pilots were young, they had already gained combat experience during the Spanish Civil War.

In the first year of WWII, JG 52 operated on the Western Front, taking part in the Battle of Britain, but it had limited success. It was only when, in the summer of 1941, the fighter wing moved east to support Hitler's invasion of the Soviet Union, that the pilots began to down hundreds of enemy aircraft. The airspace over the Soviet Union became an all-you-can-shoot buffet for the German pilots.

At this point, the Luftwaffe's Messerschmitt fighters were superior to their Soviet counterparts in speed and manoeuvrability, and at the same time, the Soviet pilots had little experience. It was a recipe that couldn't help but result in a platter of success for the Germans, such as the victories they chalked up during May 1942 in the Battle of the Kerch Peninsula. There, one squadron shot down 93 aircraft in two weeks without losing a single plane.

Hartmann's tactics were bold

JG 52 became home to some of the Third Reich's most feared and highly decorated pilots. During World War II, only nine German pilots received the Knight's Cross with Oak Leaves, Swords and Diamonds. Among them were Hermann Graf and Erich Hartmann. The latter, with 352 victories, became the most successful fighter pilot in history.

Hartmann's tactics were simple but daring: fly close to the target, shoot, then retreat quickly. Often he would only open fire after closing within 20 metres of his target.

1922-1993

NAME **ERICH HARTMANN**

TITLE PILOT IN JAGDGESCHWADER 52

Mum taught him to fly

As a young man, Erich Hartmann was taught to fly gliders by his mother, one of Germany's first female glider pilots. In 1939, Hartmann earned his aircraft pilot's licence, and his successful Luftwaffe career began in 1940. After the war, he spent 10 years in Russian captivity.

- **Flew 1,404 sorties; notched up 352 kills.**
- **Survived being shot down 14 times.**

1919-1983

NAME **GERHARD BARKHORN**

TITLE PILOT IN JAGDGESCHWADER 52

Car accident took the life of flying hero

Gerhard Barkhorn was admitted to the Luftwaffe in 1937 and selected for fighter pilot training at the start of the war. In 1945, Barkhorn was captured by Allied troops, but released soon afterwards. Barkhorn continued his career as a pilot until his retirement in 1975. He was killed in a car crash in 1983.

- **Flew 1,104 trips; notched up 301 kills.**
- **Survived being shot down nine times.**

1918-2009

NAME **GÜNTHER RALL**

TITLE PILOT IN JAGDGESCHWADER 52

German helped train British pilots

Günther Rall began his military career as an infantry officer in 1936, but was later transferred to the Luftwaffe. By 1938, he was a fighter pilot and a lieutenant. Rall was a prisoner of war in Britain, where he participated in an RAF programme that sought to pass on German pilots' skills. He returned to Germany in 1953.

- **Flew 621 trips; notched up 272 kills.**
- **Survived being shot down eight times.**

Luftwaffe fighter pilots sneaked up on their enemies, often striking before their opponent had even recognised the danger. The pilots perceived themselves as hunters stalking prey, and, unlike Soviet pilots, in each case they assessed whether to attack or avoid combat.

Many of his enemies – who referred to him as the Black Devil – never saw him coming as he pushed his Messerschmitt to the extreme and swooped down on them like a bird of prey.

Skill, daring and cool disdain characterised many of the pilots in the fighter wing that became the most victorious flying unit in the war. Hartmann described one of his encounters with German ace Walter Krupinski, aka The Count, who survived the war with 177 victories.

In the spring of 1943, Krupinski became Hartmann's new commanding officer, and immediately demonstrated how he thought the war should be fought. He crash-landed at the base, then, according to Hartmann, "came in, introduced himself, demanded another plane, went up, was shot down, scored a victory and was brought back by car. He then took another plane, scored two kills, and returned, then wanted dinner. The whole event was treated as casually as a card game."

Even the way he had crash-landed at the base initially was spectacular according to Hartmann who described how Krupinski's Messerschmitt exploded shortly after landing. Everyone thought they'd seen the last of The Count when he suddenly stepped out of the smoke. His uniform was singed, but he was otherwise unscathed. He simply smiled and complained about the Soviet flak above the Caucasus.

This cigarette case bears both the Luftwaffe's eagle and JG 53's crest – the ace of spades.

PATIENCE PAYS OFF

Pilots like Erich Hartmann and Walter Krupinski were able to easily assess what type of enemy they were up against. Soviet pilots who opened fire before they were in effective range were easy to destroy; skilled opponents were patient and waited for the opportune moment.

Pilots couldn't hear enemy planes approaching due to the noise of their own engines, and experienced flyers often hid in the clouds or flew towards the enemy with the sun directly behind them, a tactic that meant their opponent couldn't see them because of the sun's glare.

Many German pilots marked the number of kills they'd made with a series of white lines on the tail of their Messerschmitt fighters.

In desperation, some Soviet pilots deliberately flew into enemy aircraft, hoping that they themselves would survive the resulting crash landing unscathed. But the manoeuvre often cost both pilots their lives. Strategically, it made sense for the Soviets to sacrifice their aircraft if they could take out an equal number of the technically superior German planes. However, German pilots were loath to crash behind enemy lines. Most of their skilled pilots had experience of emergency landings, but if a pilot fell into the hands of the Soviets, he would almost certainly disappear without a trace.

CHIEF MECHANIC TRIED TO SAVE HIS FRIEND

By 20th April 1943, JG 52 had notched up 5,000 kills, but while the pilots received all the glory, they were completely dependent on their ground crews, and it was a firm tradition that the chief mechanic always greeted a returning pilot.

Erich Hartmann and his chief mechanic, Heinz Mertens, became such good friends that when Hartmann was forced to land behind enemy lines in August 1943, Mertens grabbed a rifle and water canteen and set out on his own to rescue him. Soviet soldiers found Hartmann first. Realising there was no chance of escape, the pilot feigned injury and was placed in the back of a truck with just a single guard. When a fortuitous attack by German Stuka dive bombers provided a distraction, the flying ace overpowered the guard, escaped from the truck and fled into a field of tall sunflowers. Both Hartmann and Mertens returned safely from behind Soviet lines and were reunited at a grand 'birthday party' – the term given to those gatherings held to celebrate a pilot's survival against the odds. JG 52 held a lot of birthday parties.

GERMANY'S LUCK TURNED

But by the winter of 1943, the war had turned against the Germans, who had just lost the Battle of Stalingrad and were in full retreat. JG 52 was beginning to suffer, too. Between April and June 1943, the fighter wing lost 23 pilots. Training was cut back due to a shortage of time and fuel, and all at a time when the Soviet air force's resistance was increasing.

The pilots flew five sorties a day, and only stopped when they were killed or injured. But no matter how many aircraft they shot down, there were always more to replace them. By autumn 1943, JG 52 was the only full fighter wing left on the Eastern Front and German aircraft were outnumbered 20 to 1. The Luftwaffe pilots continued to massacre their opponents, however, reaching 8,000 kills in December 1943.

One of the main targets of JG 52 was the Soviets' powerful Ilyushin Il-2 ground-attack aircraft – known »

PILOTS LED THE WAY FOR THE ARMY'S ADVANCE

1933 Shortly after seizing power, Hitler orders the creation of a German air force. The Luftwaffe is formally formed on 15th May, with World War I fighter pilot **Hermann Göring** as its commander.

This ring has oak leaves on the side and the Luftwaffe eagle emblem.

1936 New aircraft types and tactics – including bombing of civilian populations – are tested in the **Spanish Civil War**. Guernica is flattened.

1939 At the start of the war, Germany has the most modern air force in the world with over **7,000 aircraft**.

1940 **The Battle of Britain** is both Hitler's and the Luftwaffe's first serious defeat. The autumn clashes cost around 2,000 aircraft and more than 3,000 men.

1941 The Luftwaffe plays a key role in the attack on the **Soviet Union.** Over 4,000 aircraft support the invasion.

1942 A project to develop **long-range bombers** capable of attacking the United States is shelved. The Luftwaffe's primary mission remains to support the army.

1943 The strategy shifts from attack to **defence of the Third Reich**. The number of skilled Luftwaffe pilots falls.

1944 The Luftwaffe is strengthened with the **world's first fighter jet**, the Messerschmitt Me 262.

1945 After **unsuccessfully attempting to regain air supremacy** in January 1945, the Luftwaffe effectively ceases to exist as a combat unit.

Luftwaffe boss Hermann Göring was also the commander of Jagdgeschwader 1.

Hermann Göring

“Soviet pilots deliberately flew into enemy aircraft”

as “the flying tank” – which pulverised German panzer divisions and left thousands of burnt-out tanks in its wake. The Soviets built more than 36,000 Ilyushin aircraft. As Stalin remarked, the Red Army needed its Il-2 aircraft “like the air it breathes, like the bread it eats”.

Pressure on pilots was growing

Although JG 52 was doing its utmost to protect Germany’s ground troops, the pilots were fighting a hopeless battle. Every downed Soviet plane was replaced by more new ones. In 1944, Soviet production peaked with over 40,000 aircraft being deployed, and while German aircraft production reached similar levels, their planes were needed on several fronts.

At the same time, the Soviets had begun developing aircraft types that were on par with the Germans’. From 1944, many German pilots deliberately avoided battling the best Soviet fighters, such as the Yak 3, which were faster and had a better rate of climb than the earlier Soviet fighters.

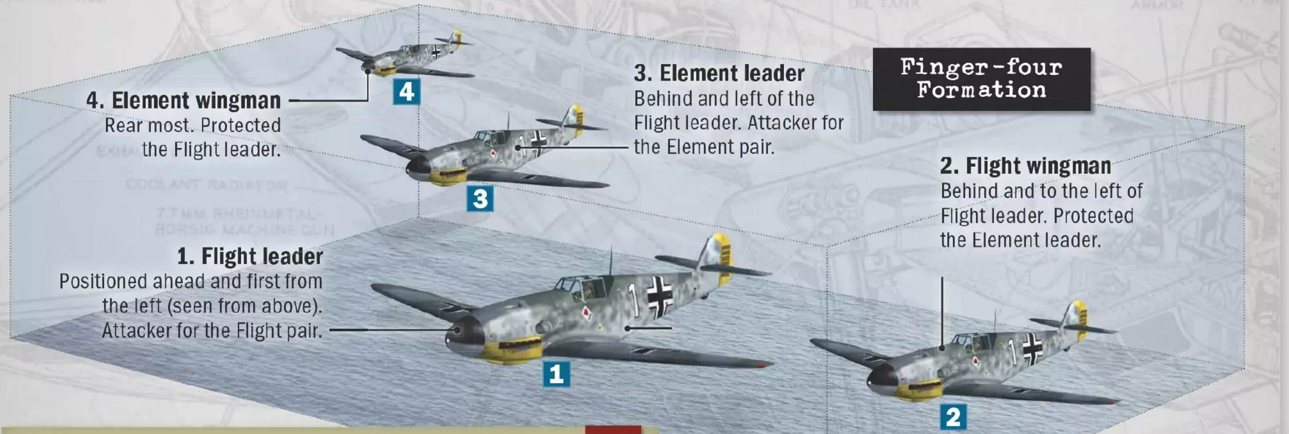
The Soviet advance also put tremendous pressure on JG 52’s air bases. In January 1944, Soviet tanks arrived for a pre-dawn attack on the base near Kropyvnytskyi in Ukraine, destroying eight aircraft before the Red Army was pushed back, and the pilots were able to fly the rest of the planes to safety.

On other occasions, JG 52 would be forced to flee with ground crew packed inside the Messerschmitt fighters’ fuselages. If the mechanics removed the radio, armour plates and other inserts, four people could squeeze into the rear section. JG 52 had to switch its base around 400 times during its time on the Eastern Front. Fields were quickly transformed with runways, tents and makeshift barracks and were then abandoned again, often after just a few days. Bad weather sometimes turned these temporary bases into mud holes,

STRATEGY

Aircraft attacked in pairs

The Luftwaffe’s success was helped by a tactic developed by ace pilot Werner Mölders. Known as the Finger-four Formation, the tactic had several advantages: each of the four planes had good manoeuvring space, could protect one another and could quickly split into two pairs if necessary.

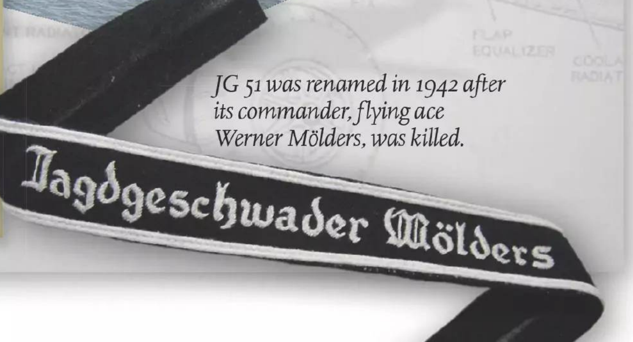

Finger-four Formation
1. Flight leader Positioned ahead and first from the left (seen from above). Attacker for the Flight pair.
2. Flight wingman Behind and to the left of Flight leader. Protected the Element leader.
3. Element leader Behind and left of the Flight leader. Attacker for the Element pair.
4. Element wingman Rear most. Protected the Flight leader.
1
2
3
4

FACTS

GERMANS TOPPED THE CHARTS

A flying ace was a fighter pilot who had shot down or ‘killed’ a number of enemy aircraft in combat.

- The title emerged during World War I and was bestowed on the Red Baron, German pilot Manfred von Richthofen, who downed 80 aircraft.
- Erich Hartmann was WWII’s top fighter pilot with 352 victories.
- German pilots dominated the list of top flying aces. The highest placed non-German was the Finn Ilmari Juutilainen, who achieved 94 kills.


Jagdgeschwader Mölders

JG 51 was renamed in 1942 after its commander, flying ace Werner Mölders, was killed.

bogging down tankers, and leaving horses to haul the fuel to the Messerschmitt fighters instead. Food and fuel were limited, spare parts for aircraft had to be transported along stretched supply lines, and many of the men were succumbing to illnesses such as pneumonia. In addition, there were nature's uninvited guests: lice and rats. Erich Hartmann described how pilots could hear lice popping when they held their clothes up to an open fire.

The most skilled pilots earned brief respites from their harsh life at the front when they were recalled to Germany to receive military decorations. The awards were made according to a simple point system. Shooting down a single-engine enemy aircraft earned one point, while a downed twin-engine earned two points and so on. On 25th August 1944, Hartmann was presented with the Knight's Cross with Oak Leaves, Swords and Diamonds by Adolf Hitler at *Wolfsschanze* – The Wolf's Lair – military headquarters in East Prussia. Tightened security following a failed assassination attempt led to security demanding the pilot's sidearm as he was about to be ushered in to see the Führer, but Hartmann refused, stating that he would not receive the award if he was suspected of disloyalty. Hitler's aide relented and Hartmann was permitted to wear his Walther pistol during the ceremony.

SOVIET ARCHIVES PROVED THE SUCCESS RATE

Back on the Eastern front, JG 52 reached 10,000 kills in early September 1944. Germany's ministry of propaganda took full advantage of the success – news of glorious victories at the front were becoming a rarity and the population was becoming demoralised. Joseph Goebbels even composed a special tribute to JG 52 and had it aired on German state radio.

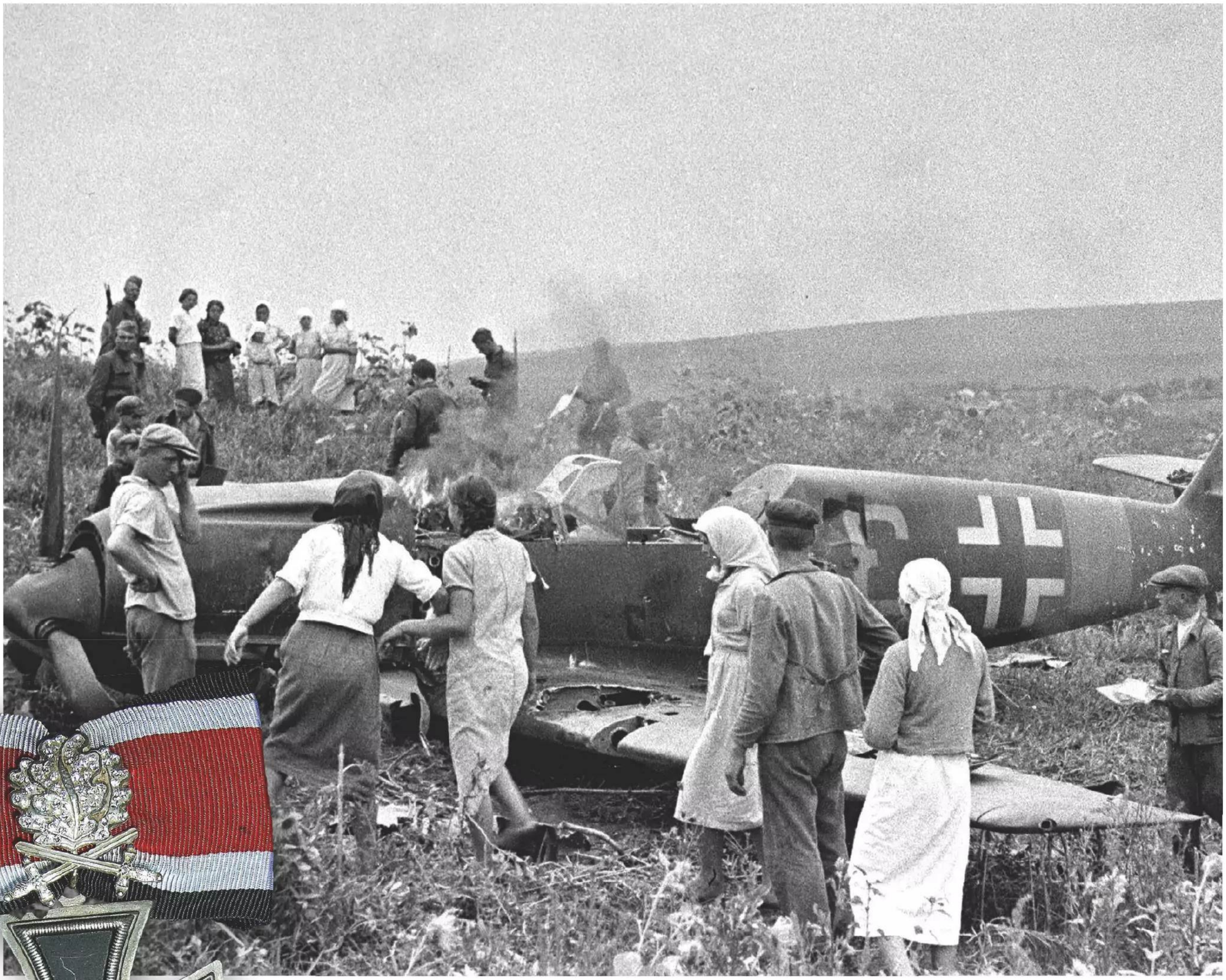
After the war, some historians questioned whether JG 52's phenomenally high kill rate was genuine or had been inflated by German propaganda that celebrated the wing's greatest pilots as folk heroes. But research into the Soviets' recently opened wartime archives confirms the vast majority of the kills with corresponding records of Soviet aircraft shot down by German fighters. It was confirmation that JG 52 was by far the most successful fighter wing of the war.

During the first half of the war, JG 52 's tactics were far ahead of their enemy's, not least their famous Finger-four Formation, in which the planes flew in groups of four, with two pairs covering one another. This configuration provided much greater manoeuvrability than the Allied wedge-shaped formation. As the war progressed, however, the Allies adopted the same tactics.

The pilots in JG 52 flew far more missions than Allied pilots, which also gave the German pilots more combat experience. While Allied pilots had rest periods and took turns to complete missions, the German pilots flew continually until they were either captured or killed.

By autumn 1944, it became increasingly obvious that the end was near. Stalin's troops gradually pushed the Germans back towards the West. The fighter wing »

While JG 52 only flew Messerschmitt Bf 109s, their counterparts in JG 51 used both Bf 109s and Focke-Wulf FW 190s.



It was deadly for German pilots to land behind enemy lines. If the pilots survived the landing, there was a high risk of being killed either by Soviet civilians or Red Army soldiers.

Mölders 1941 Knight's Cross with Oak Leaves, Swords and Diamonds.

flew above Romania, Hungary, Austria, Poland and then over the Fatherland itself, where eventually they were given the hopeless task of trying to defend Berlin against Allies approaching from both east and west.

Ten years in prison

During the last days of the war, in May 1945, Erich Hartmann and Colonel Hermann Graf, then commander of JG 52, received a final order from Luftwaffe General Hans Seidemann. While the rest of JG 52 was to surrender to the Soviets, Hartmann and Graf must fly to Dortmund and give themselves up to the British. Seidemann didn't want the Soviets to be given the satisfaction of capturing the fighter wing's most decorated pilots, but the pair ignored the order and remained with their comrades instead.

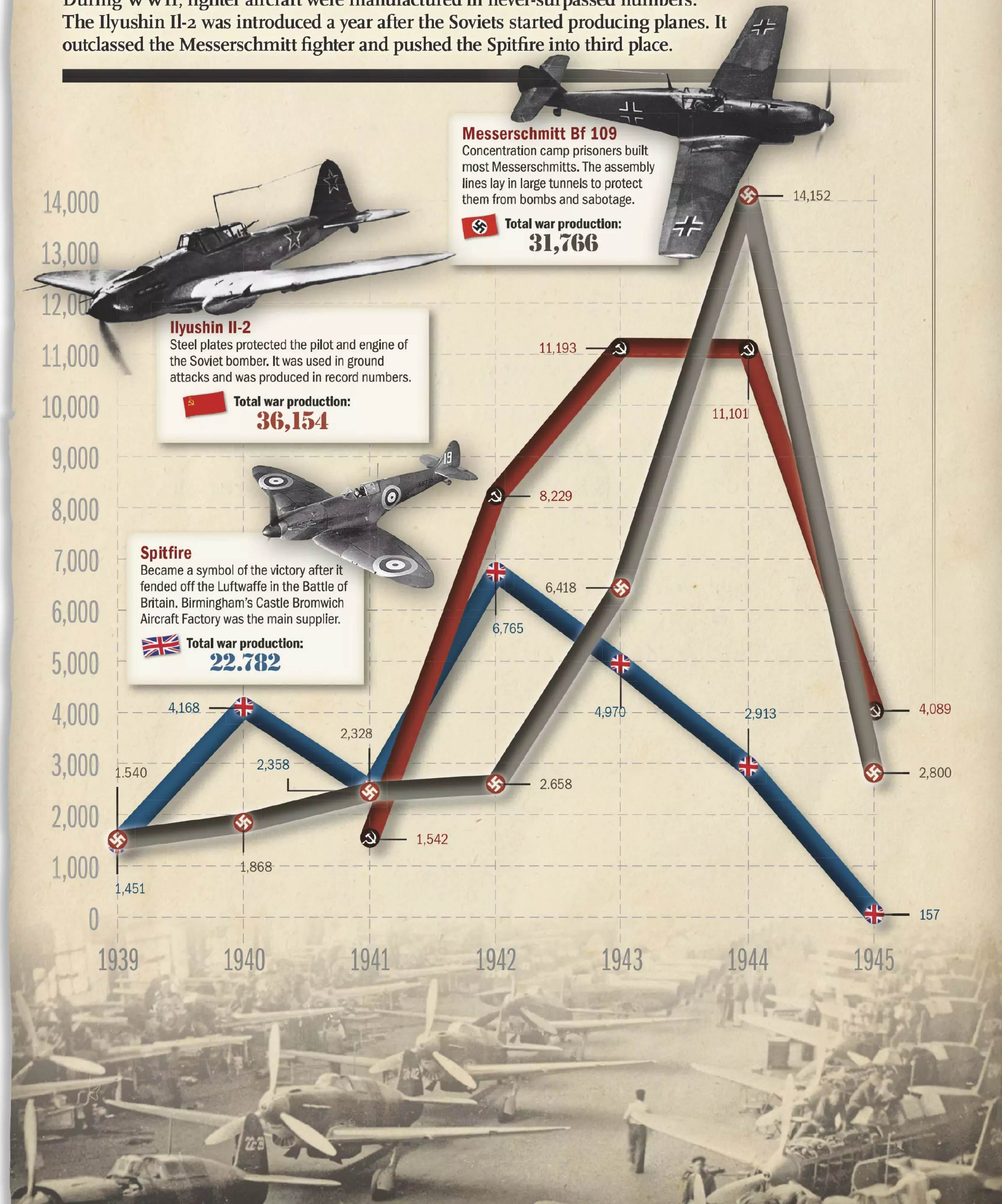
The two men paid a high price for their loyalty. Graf was held in Soviet captivity for five years, while Hartmann was only returned to Germany and his wife, Ursula, in 1955.

The total number of kills made by JG 52 will never be known for sure, as records for the latter part of the war were lost. The Luftwaffe downed around 45,000 Soviet aircraft over the course of the war, with JG 52 probably accounting for around 10,600 of those kills.

> "German pilots were loath to crash behind enemy lines"

Soviets built the most

During WWII, fighter aircraft were manufactured in never-surpassed numbers. The Ilyushin Il-2 was introduced a year after the Soviets started producing planes. It outclassed the Messerschmitt fighter and pushed the Spitfire into third place.



Messerschmitt Bf 109
Concentration camp prisoners built most Messerschmitts. The assembly lines lay in large tunnels to protect them from bombs and sabotage.

Total war production:
31,766

Ilyushin Il-2
Steel plates protected the pilot and engine of the Soviet bomber. It was used in ground attacks and was produced in record numbers.

Total war production:
36,154

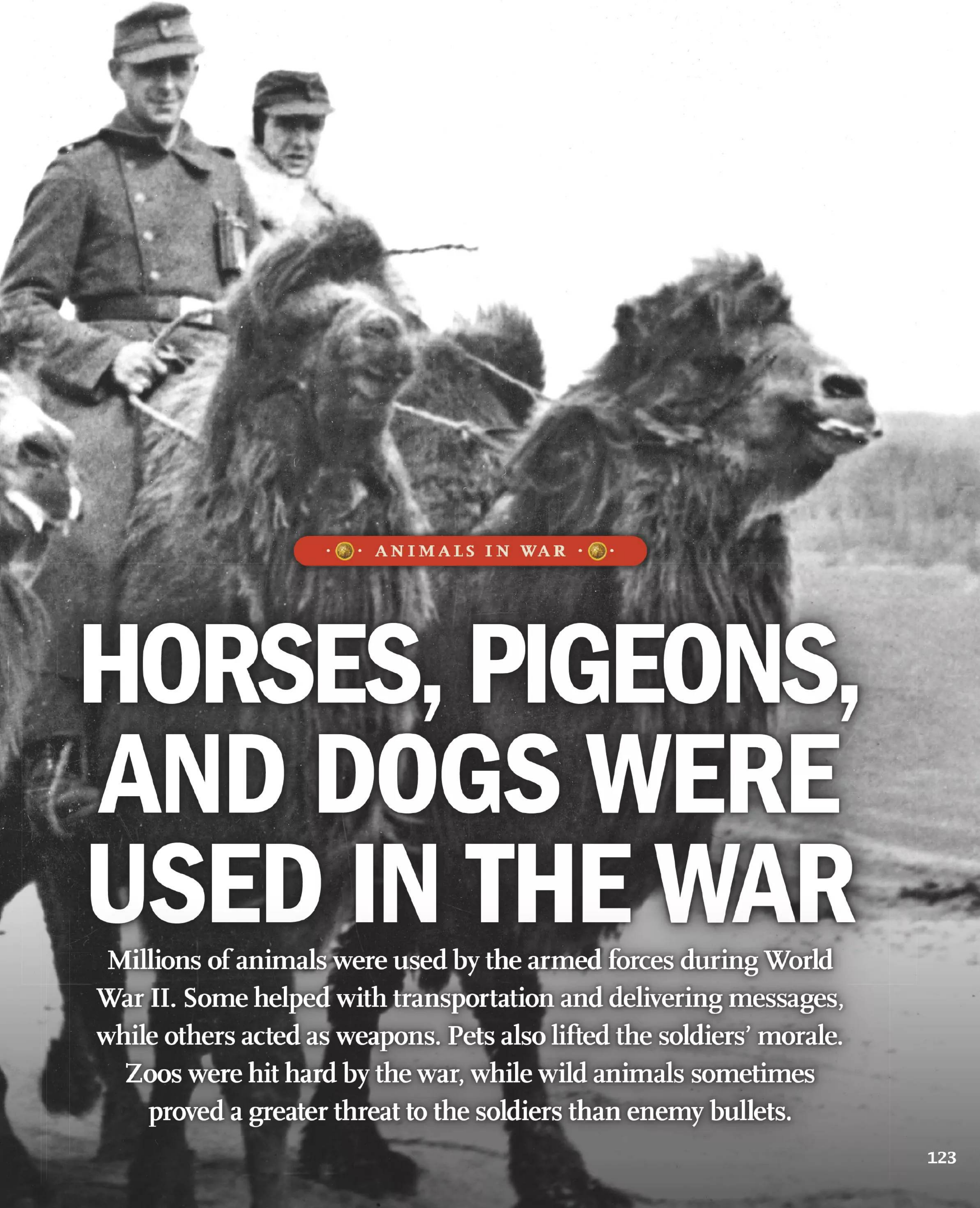
Spitfire
Became a symbol of the victory after it fended off the Luftwaffe in the Battle of Britain. Birmingham's Castle Bromwich Aircraft Factory was the main supplier.

Total war production:
22.782

14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1939
1940
1941
1942
1943
1944
1945
14,152
11,193
11,101
8,229
6,418
6,765
4,168
4,970
2,913
4,089
2,328
1.540
2,358
2,800
2.658
1,542
1,868
1,451
157

In the Caucasus region, some German soldiers switched from horses to camels during the campaign against the Soviet Union. But the German army also employed millions of horses in the east.

1943



ANIMALS IN WAR

HORSES, PIGEONS, AND DOGS WERE USED IN THE WAR

Millions of animals were used by the armed forces during World War II. Some helped with transportation and delivering messages, while others acted as weapons. Pets also lifted the soldiers' morale. Zoos were hit hard by the war, while wild animals sometimes proved a greater threat to the soldiers than enemy bullets.

A coded message *could be rolled up in a tube attached to the pigeon's leg. Some birds filmed enemy positions with cameras.*

USEFUL ANIMALS

Millions of animals participated in the war

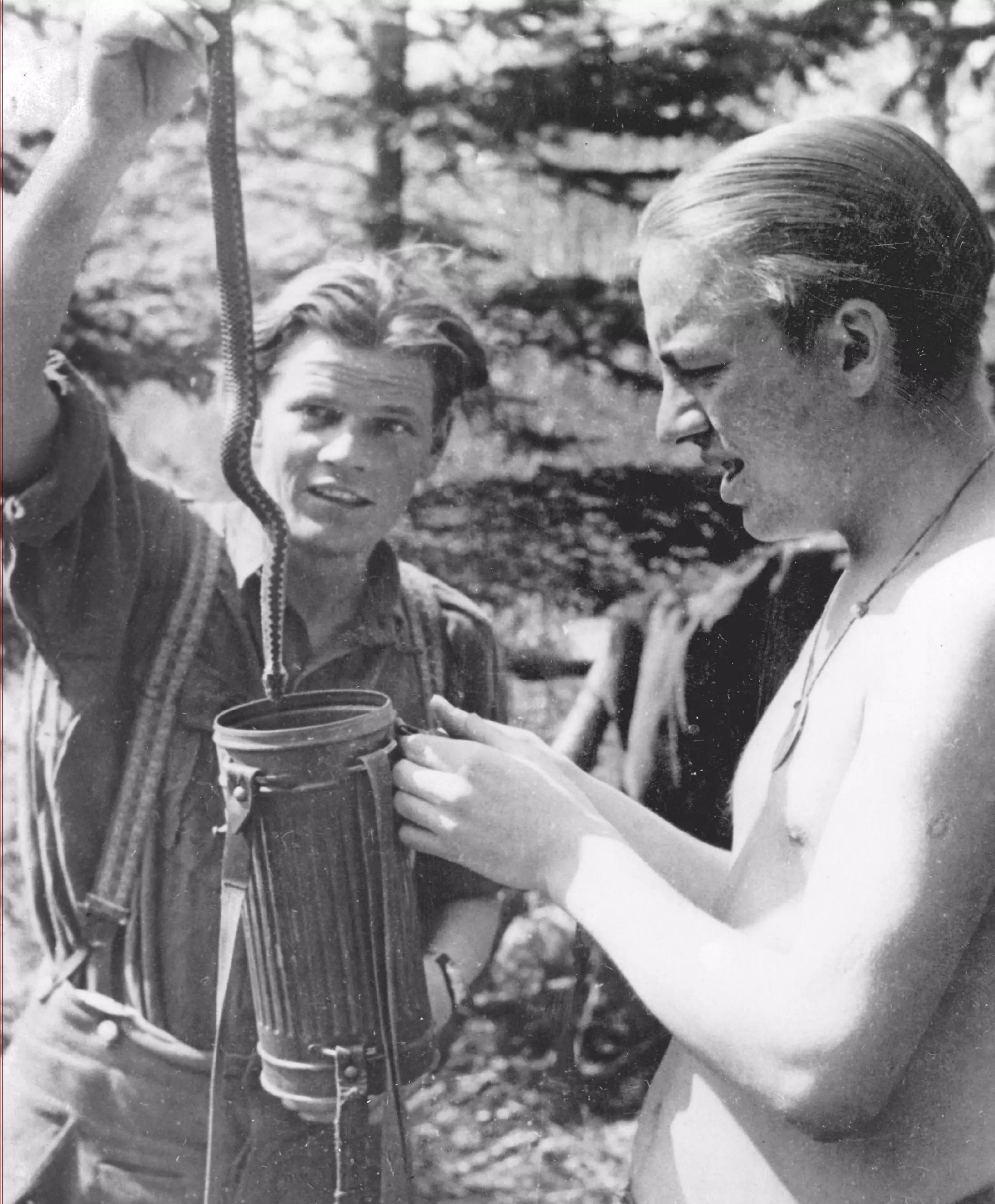
Millions of animals took part in World War II either as mascots or in more practical roles, including dogs that would guard and track enemies. US, British, and German forces had largely abolished cavalry units, although Italy, Poland, and the Soviets still had some. Horses became important, nonetheless, especially for transportation. Pigeons were used for surveillance and to send messages. A British Beaufort bomber that was shot down in the icy sea off Norway in 1942 had a pigeon on board. The crew managed to release the pigeon, which carried a message with their position to their base, saving the mens' lives.

Carrier pigeons *replaced radio transmissions where secrecy was paramount, such as in the run up to the D-Day landings. The British used around 250,000 birds during the war.*

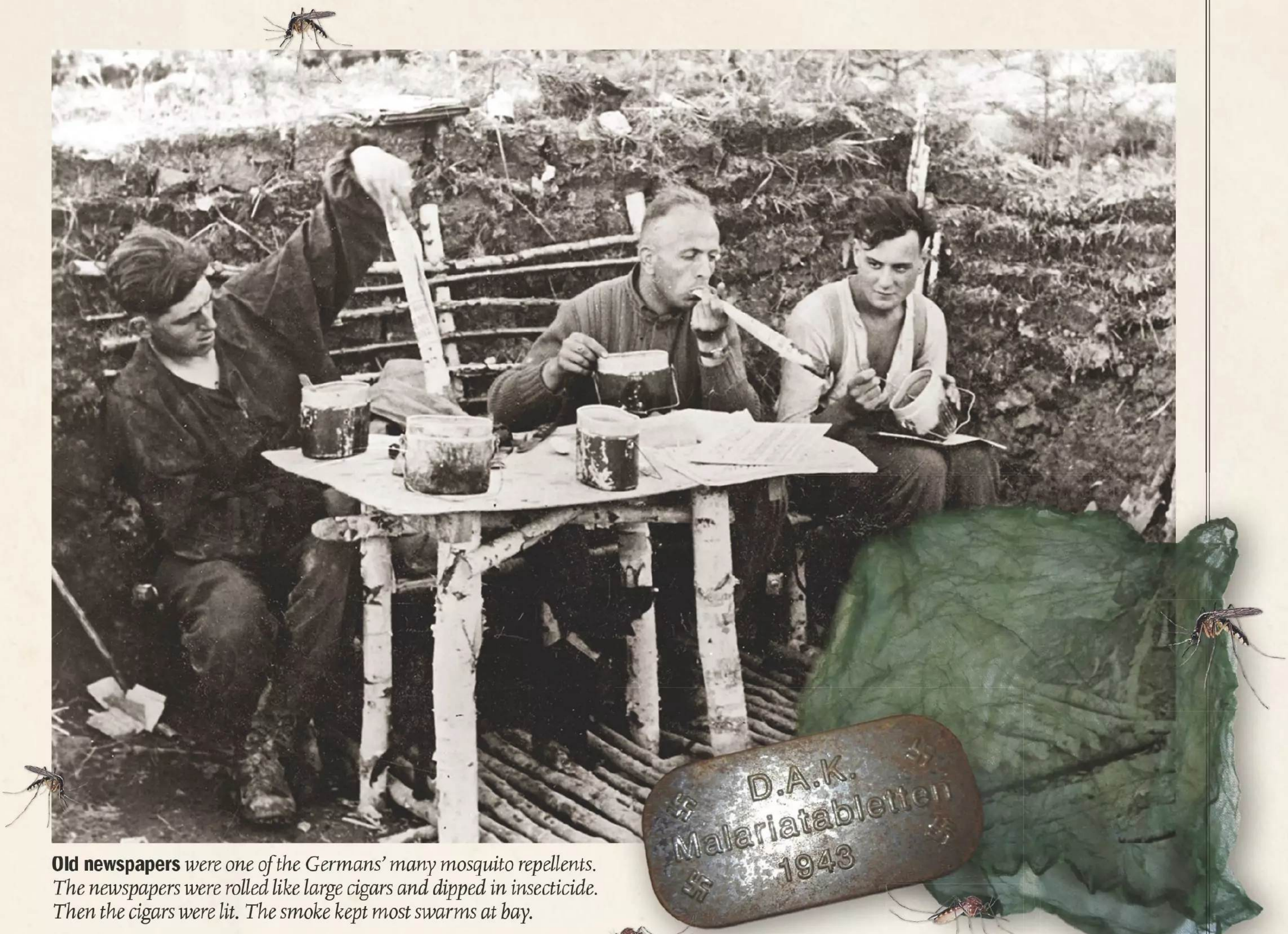
PDSA
For
Gallantry
WE ALSO SERVE

The medal for bravery *was awarded to 32 pigeons, 18 dogs, three horses, and a cat. One of the dogs was the terrier-cross Rip, who found over 100 people trapped in the ruins during the London Blitz. Dogs were mainly used for rescue work in ruins and on the battlefield, as guard dogs, and to search areas for hidden enemies and explosives.*

The cavalry was obsolete, *but horses still played a role in the war, carrying people and equipment, and hauling heavy loads, especially on the Eastern Front. The Germans' need for horses increased amid growing fuel shortages. The Germans used 2.75 million horses during the war.*



Poisonous snakes *made life difficult on the Eastern Front. The German forces also had to pass through wide belts of swampy marsh that was swarming with exotic insects. Photos of brave young German soldiers on snake hunts were used in propaganda back home.*


D.A.K.
Malariatabletten
1943

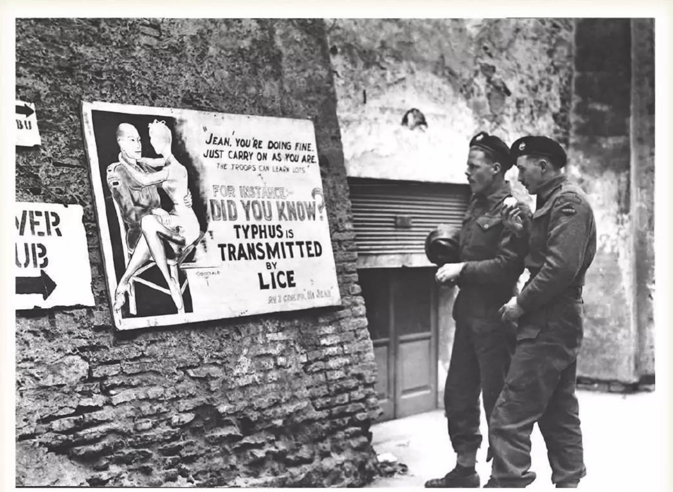
Old newspapers *were one of the Germans' many mosquito repellents. The newspapers were rolled like large cigars and dipped in insecticide. Then the cigars were lit. The smoke kept most swarms at bay.*

Mosquitoes spread malaria *on the Eastern Front and in Asia. The luckiest soldiers had mosquito nets and pills with synthetic quinine that could cure the disease.*

DANGEROUS ANIMALS

Nature featured in propaganda

Photos showing frontline soldiers coping with nature's many dangers were used by the German propaganda machine to boost civilian morale. Among the Allies, the health service ran campaigns warning soldiers about diseases transmitted by animals. Nature was also exploited in warfare. For example, on their withdrawal from Italy in 1943, the German forces flooded the previously drained Pontine Marshes south of Rome to foster a deadly belt of malaria-carrying mosquitoes. The Allies, equipped with anti-malarial drugs, did not get sick, but the number of Italians struck by the disease increased drastically from 1944 until 1950, when the swamps were drained once more.

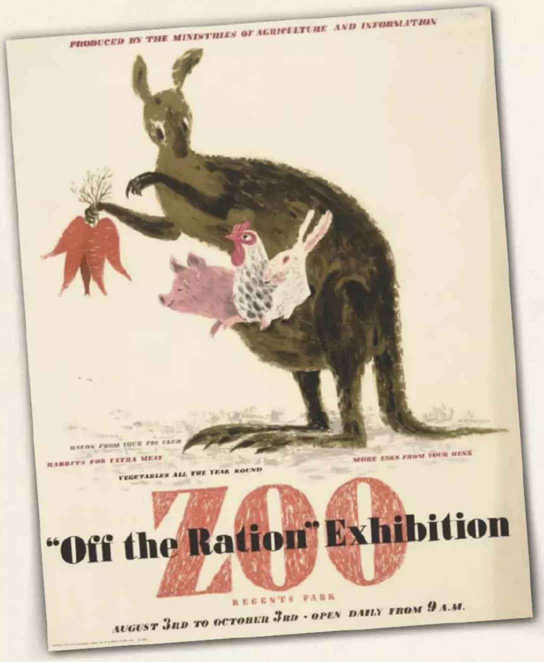

"JEAN, YOU'RE DOING FINE.
JUST CARRY ON AS YOU ARE.
THE TROOPS CAN LEARN LOTS"
FOR INSTANCE-
DID YOU KNOW?
TYPHUS IS
TRANSMITTED
BY
LICE

Infestations of lice *were allegedly spread among the soldiers by prostitutes. Propaganda posters warned troops that lice could infect them with typhus, a potentially fatal disease.*

EXOTIC ANIMALS

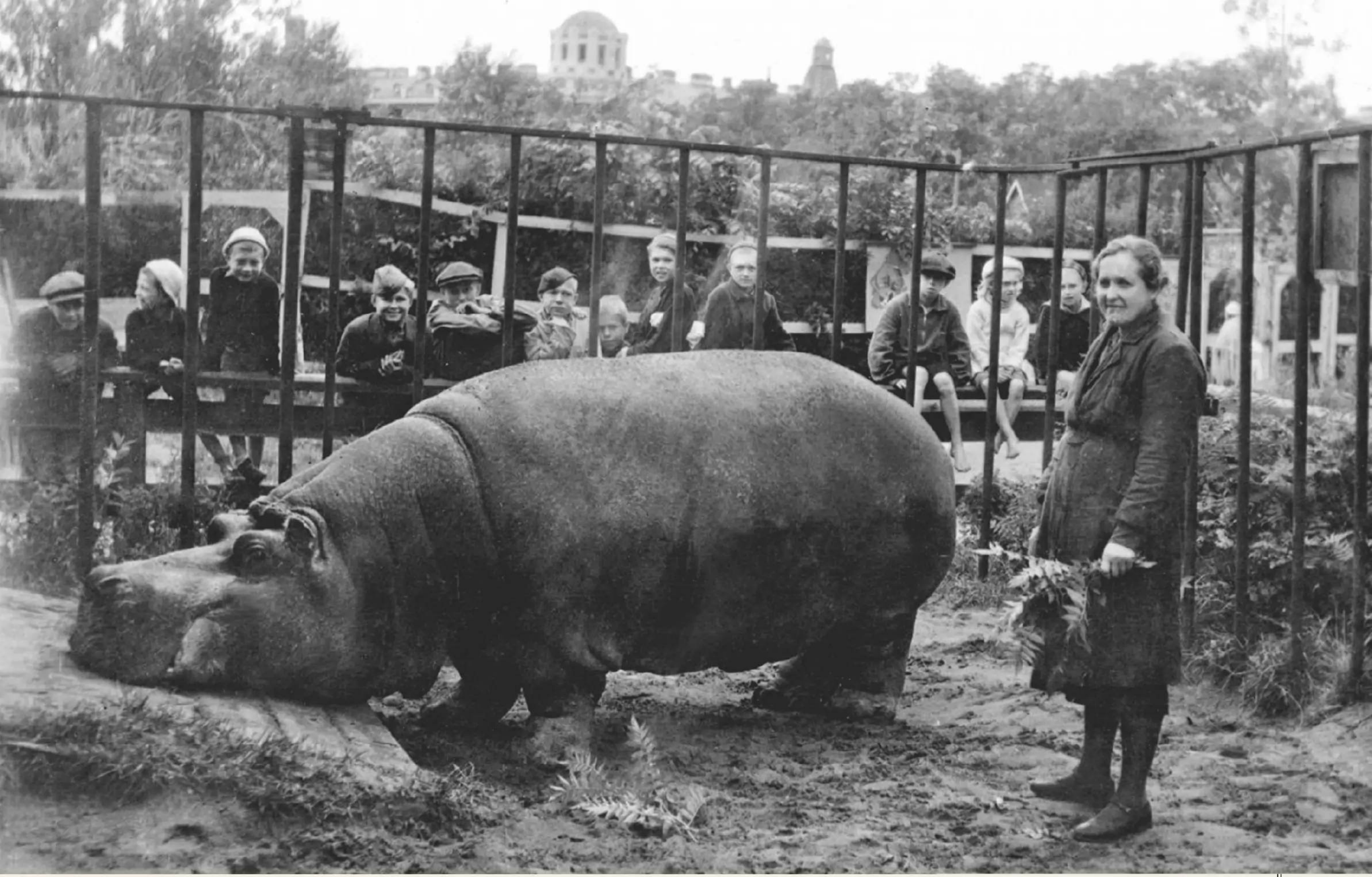
Zoo animals suffered greatly during the war

Exotic animals in Europe's zoos often became victims of the war. The caged animals were exposed to air raids that they could not escape and also suffered from a lack of food. Berlin Zoo was completely destroyed, with only 91 of the establishment's 3,715 animals surviving the war. Many animals in British zoos were temporarily housed on farms in the countryside. These measures helped many elephants and lions to survive the war. Others weren't so lucky. Some of the larger dangerous animals in Belfast Zoo, for example, were killed because residents feared that they might escape if their cages were hit in an air strike.


PRODUCED BY THE MINISTRIES OF AGRICULTURE AND INFORMATION
BACON FROM YOUR PIG CLUB
RABBITS FOR EXTRA MEAT
MORE EGGS FROM YOUR HENS
VEGETABLES ALL THE YEAR ROUND
ZOO
"Off the Ration" Exhibition
REGENTS PARK
AUGUST 3RD TO OCTOBER 3RD · OPEN DAILY FROM 9 A.M.

London Zoo held exhibitions *where visitors learned how to keep pigs, rabbits and chickens as well as grow vegetables to supplement rationing.*

A dead giraffe *was one of the victims of the Allied bombing of Berlin. The raid completely destroyed the city's zoo. After the war, the site was rebuilt according to modern principles, with large enclosures that mimicked the animals' natural habitats.*



Belle the hippopotamus *could thank her keeper, Yevdokia Dashina, for her survival during the siege of Leningrad. The city's water supply was cut off, leaving Belle's pool empty. But Dashina fetched 40 litres of water daily from the Neva River to keep Belle's skin moist. The hippo's feed was rationed to just four-to-six kilogrammes per day – much less than the 40 kilogrammes normally given to adult animals.*

The bear cub Voytek *was found motherless by Polish troops in Iran in 1943. The bear was enlisted in the Polish army with a name, rank and number.*

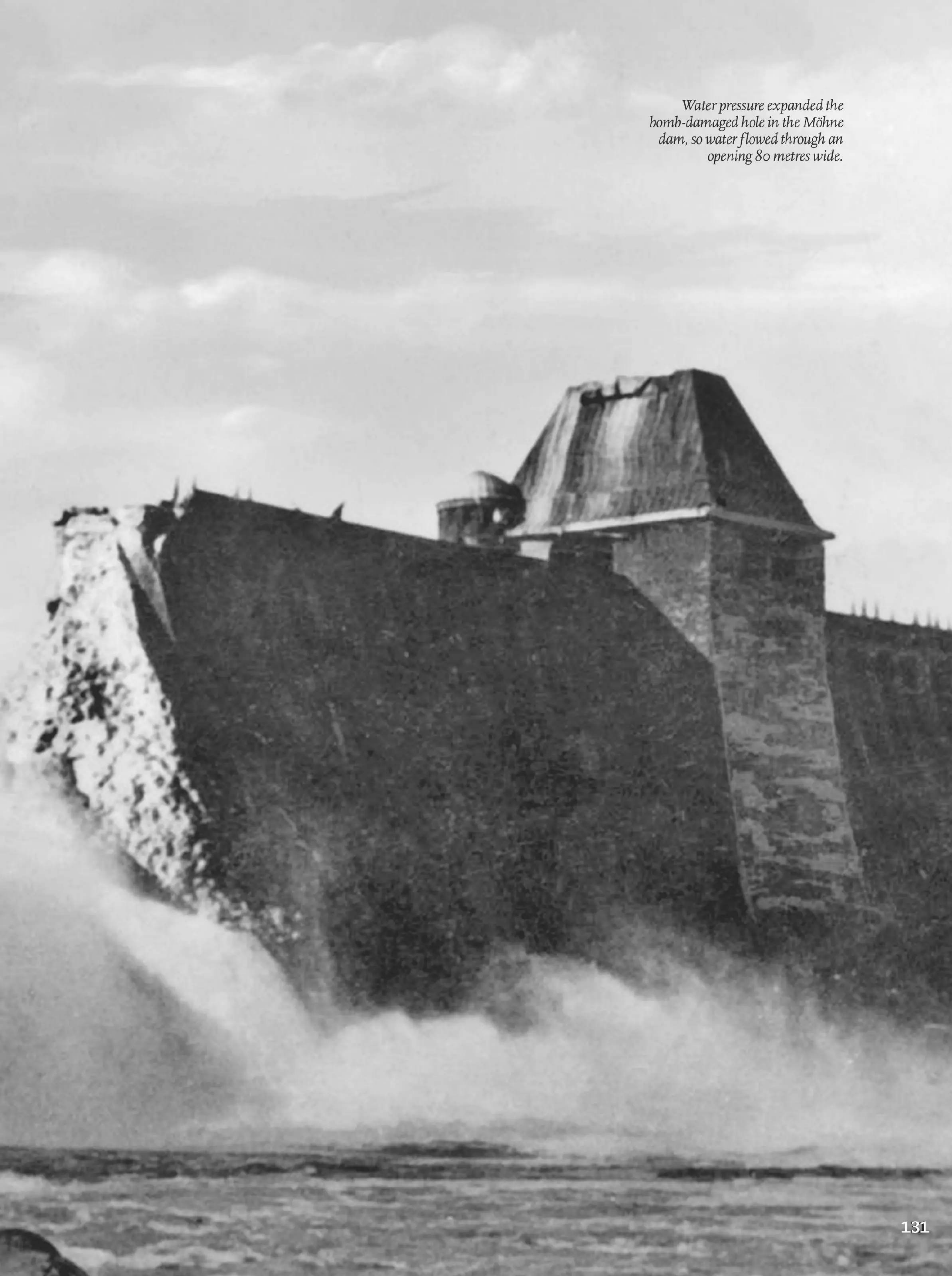
The pelicans in London Zoo *managed on small chunks of fish. The keepers shared their rations with the birds.*

DAMBUSTERS SMASH NAZI WAR EFFORT

Under cover of darkness, British bombers head to the Ruhr valley, heart of the Nazi war machine. Underneath the planes hang top-secret bombs designed to destroy three large dams using a technique that's never been tried before. No one knows if the bombs will work in practice.

1943

17TH MAY



Water pressure expanded the bomb-damaged hole in the Möhne dam, so water flowed through an opening 80 metres wide.

Germany, 1943

THE STAGE IS SET

GERMANY
Ruhr district

In early 1942 Albert Speer was appointed Germany's Minister of Armaments. Within a year the former architect has doubled the Third Reich's arms production. A large proportion of the factories' energy comes from huge dams in the Ruhr district. The British are forced to carry out an act of sabotage.

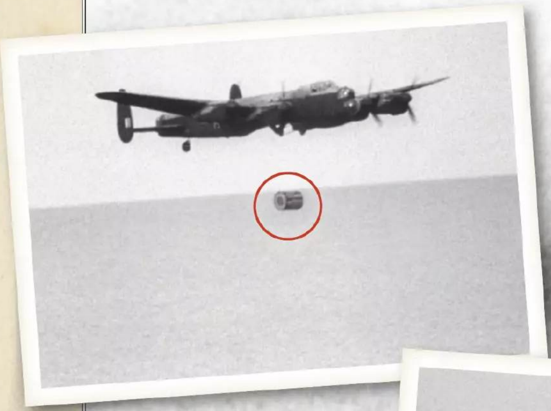
Two British boys found themselves witnesses to a strange event in spring, 1943. The boys were playing in a deserted coastal area at Herne Bay in eastern England as large bombers repeatedly swept across the cliffs and out into the North Sea. The boys pressed themselves down in the long grass and from their vantage point watched as the planes dropped bombs out over the sea – bombs that behaved unusually. They skipped across the water several times like skimming stones before exploding beneath the surface to send gigantic water columns high into the air.

The boys had no idea they were eyewitnesses to the final tests of a new secret weapon – a bomb that could hop across the surface of the water. Just a few days later the invention would be road-tested in one of the most spectacular bombing raids of the entire war: an attack on three dams in the heart of Germany, all protected by murderous anti-aircraft guns.

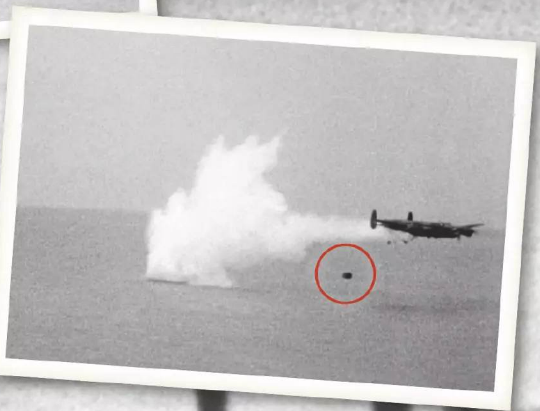
Dams were the perfect target

The British had been aware of the three major German dams in the Ruhr Valley – Möhne, Edersee and Sorpe – since the outbreak of war. The hydropower stations connected to the dams produced electricity for Germany's heavy industry and were crucial for the Nazis' arms production. In addition, the reservoirs supplied drinking water to millions of Germans.

A bombing raid was no simple task, however. The dams were built to withstand the pressure of millions of tons of water, while the Germans were naturally aware of their strategic importance. Barrage balloons hung over the largest Möhne dam while heavy torpedo nets were deployed behind the dam beneath the water to block torpedoes dropped from enemy aircraft before they could reach the concrete wall. At



During tests up to the night of the raid, the bomb was dropped over open water.



The bomb rotated quickly in an opposite direction to the plane's flight, and skimmed over the water.

the same time, powerful anti-aircraft guns would render any airborne assault something akin to a suicide mission. Only one thing favoured an attack: the Germans would consider it so unlikely they might not be sufficiently vigilant to one.

Despite the fact the RAF had plenty of cold-blooded pilots willing to fly on such a mission, the British needed a brand new weapon. A conventional bomb dropped against the dam could not possibly smash through the construction.

Original plan was met with anger

Ambitious engineer Barnes Wallis had spent the entire war trying to work out how to blow a hole in the Ruhr dams. Wallis was convinced a devastating explosion was possible if it occurred below the water level and quite close to the dam.

The creative inventor devised the idea of dropping a bomb from low altitude where it could skip over the torpedo net, hit the top of the dam on the reservoir's side before rolling down the concrete wall below the water line to explode at a predetermined depth.

His theory triggered immediate objections. The bomb would need to be dropped from such a low height that a bomber would need to fly with spotlights to avoid hitting the ground.

"No way", was the angry reply of Air Chief Marshal Sir Arthur "Bomber" Harris of Bomber Command. "I will not have aircraft flying about with spotlights on in a defended area. Get some of these lunatics under control and if possible locked up", he raged.

Despite Harris' objections, Charles Portal, head of the Royal Air Force, decided the idea had enough merit to warrant testing. Bombing the German dams was high on his wish list, even though he considered the task almost impossible.

Wallis had built a 1:50 scale model of the Möhne dam and quickly proved conventional bombs wouldn't be of much use. Wallis gained permission to experiment on a real dam in Wales, and his trials substantiated his theory that only an explosion underwater and in contact with the dam wall could potentially breach it.

In April 1942, Wallis believed he had the solution to how the weapon should be designed: A rotating spherical bomb dropped from a low-flying plane would hit the water at such an acute angle and with such speed it would skim over the surface.

Two months later, the engineer performed more tests in a large, long indoor pool using tennis ball-sized spheres for bombs. These went so well that the RAF gave him the means to carry out full-scale trials. These took place on a beach in Dorset, and Wallis ordered 150 bombs, each with a weight of four tons. British Avro Lancaster bombers

NAME **BARNES WALLIS**

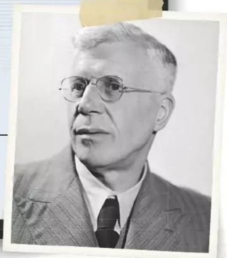
TITLE ENGINEER

1887-1979

Bomb's designer was full of ideas

Barnes Wallis was excited about anything that could fly. From 1913 he worked for Vickers constructing airships and tinkered with aircraft design.

In addition to the bouncing bombs that were used to destroy the dams, Wallis created several other types – not least the so-called "Grand Slam" bomb. The war's most powerful non-atomic explosive targeted the likes of railways and submarine bases.

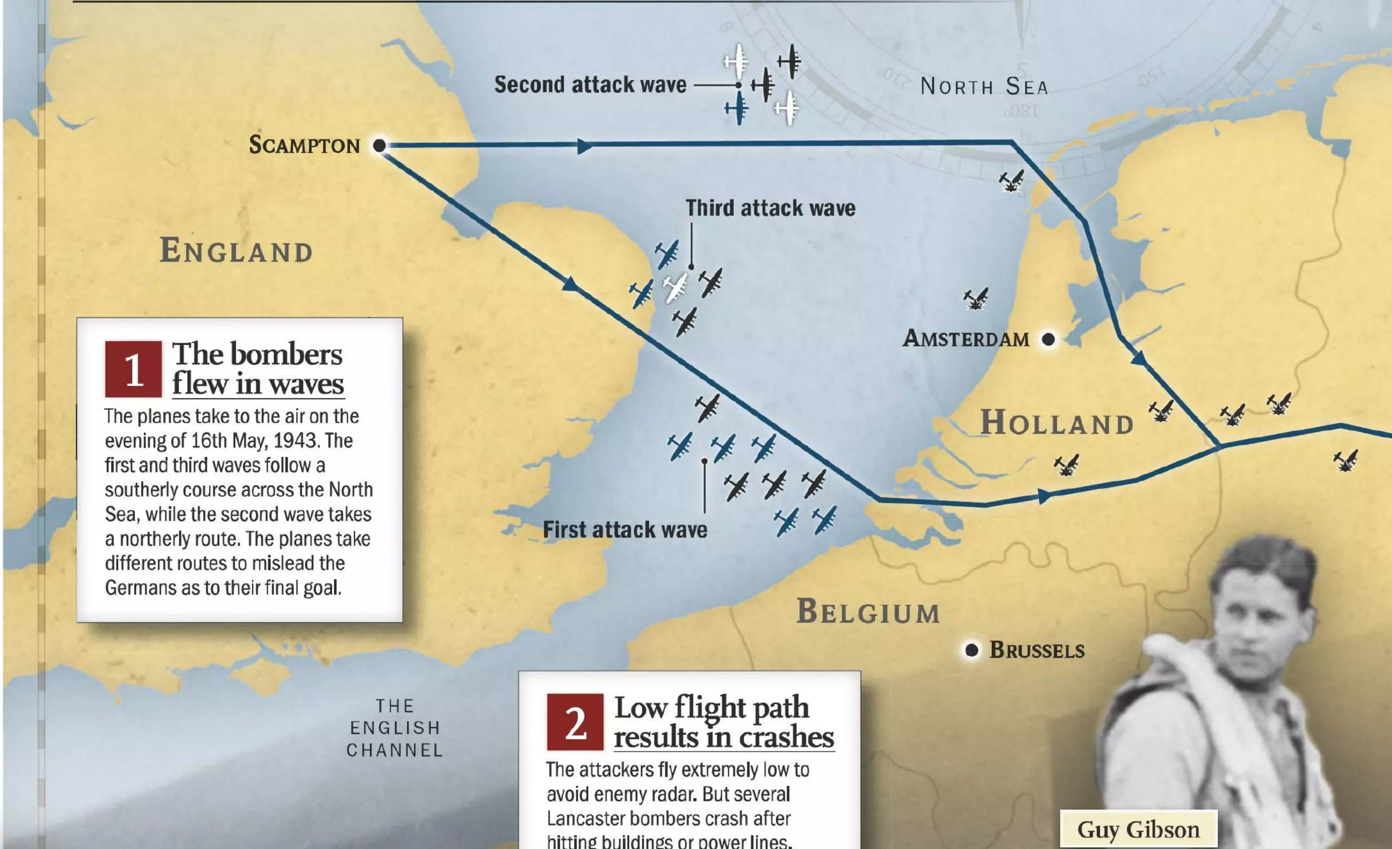


- **Trained as a marine engineer.**
- **Worked in the air industry until 1971.**

Designers monitored how the bomb worked in practice by watching from land.

The road to Germany was an obstacle course

The Germans knew that the dams in the Ruhr district were obvious targets, and so the bombers had to navigate through the crossfire of anti-aircraft guns. Only eight out of 19 aircraft reached the target while the rest crashed or had to return.

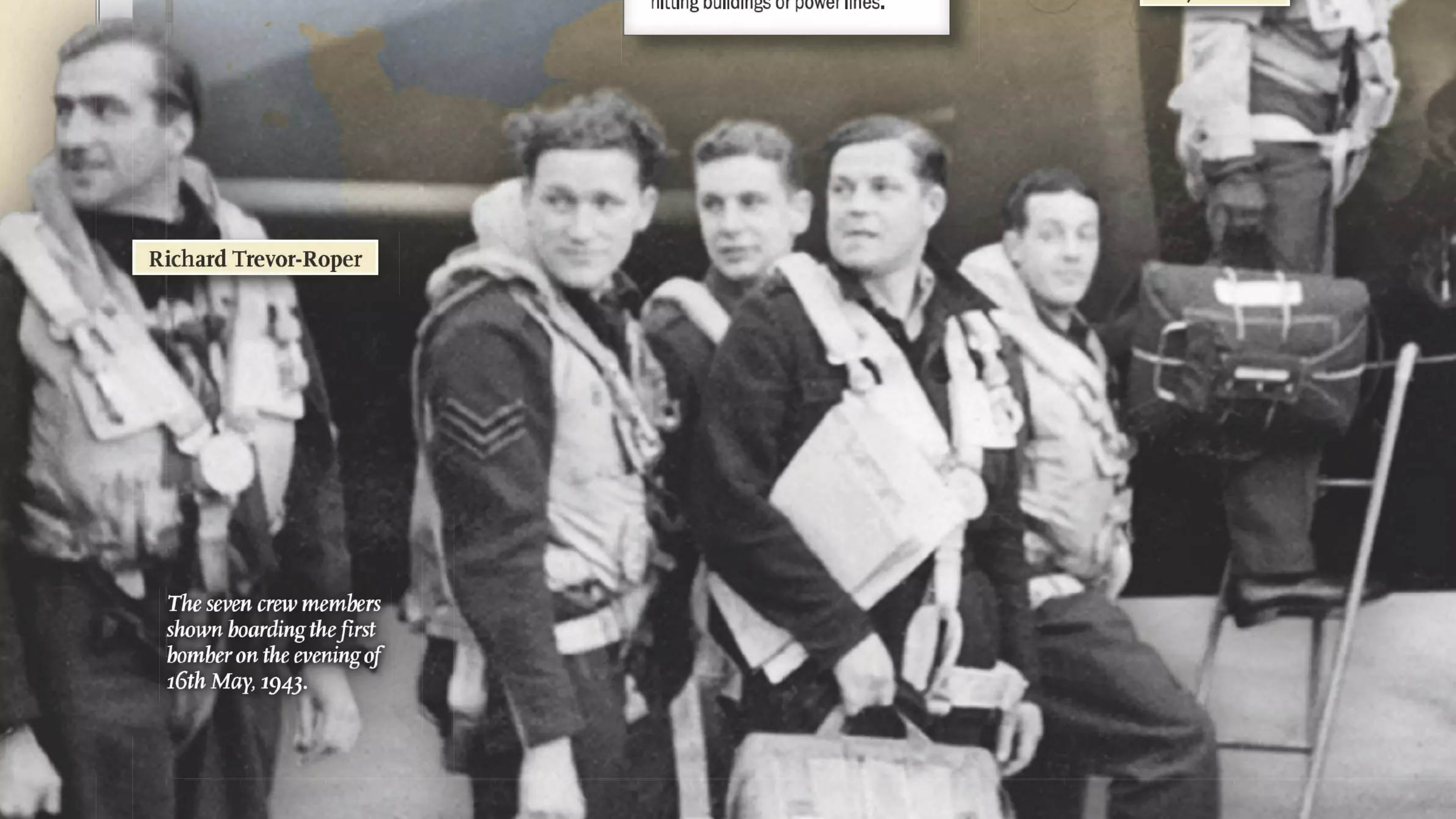

Second attack wave
North Sea
Scampton
Third attack wave
England
Amsterdam
Holland
First attack wave
Belgium
Brussels
The English Channel

1 The bombers flew in waves

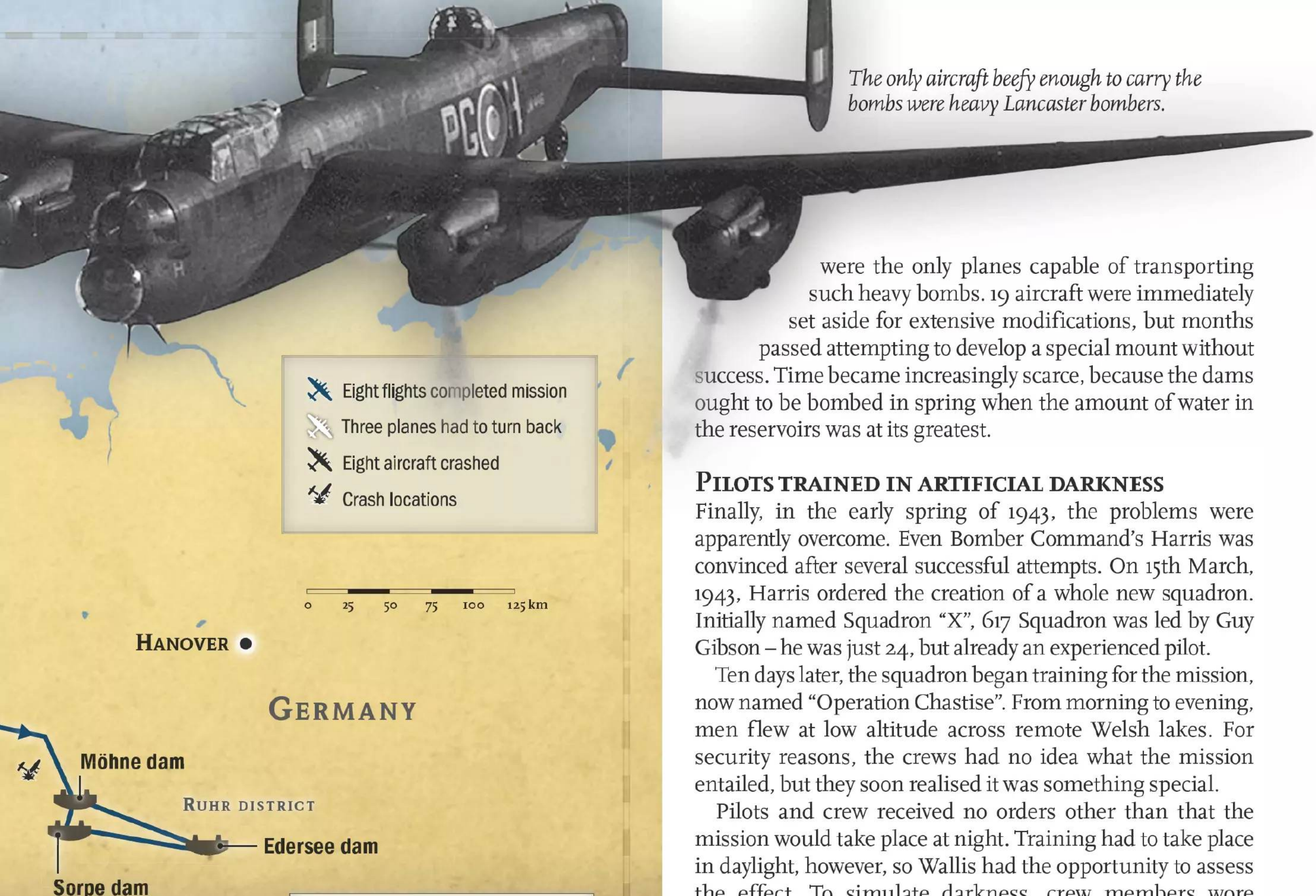
The planes take to the air on the evening of 16th May, 1943. The first and third waves follow a southerly course across the North Sea, while the second wave takes a northerly route. The planes take different routes to mislead the Germans as to their final goal.

2 Low flight path results in crashes

The attackers fly extremely low to avoid enemy radar. But several Lancaster bombers crash after hitting buildings or power lines.


Guy Gibson
Richard Trevor-Roper

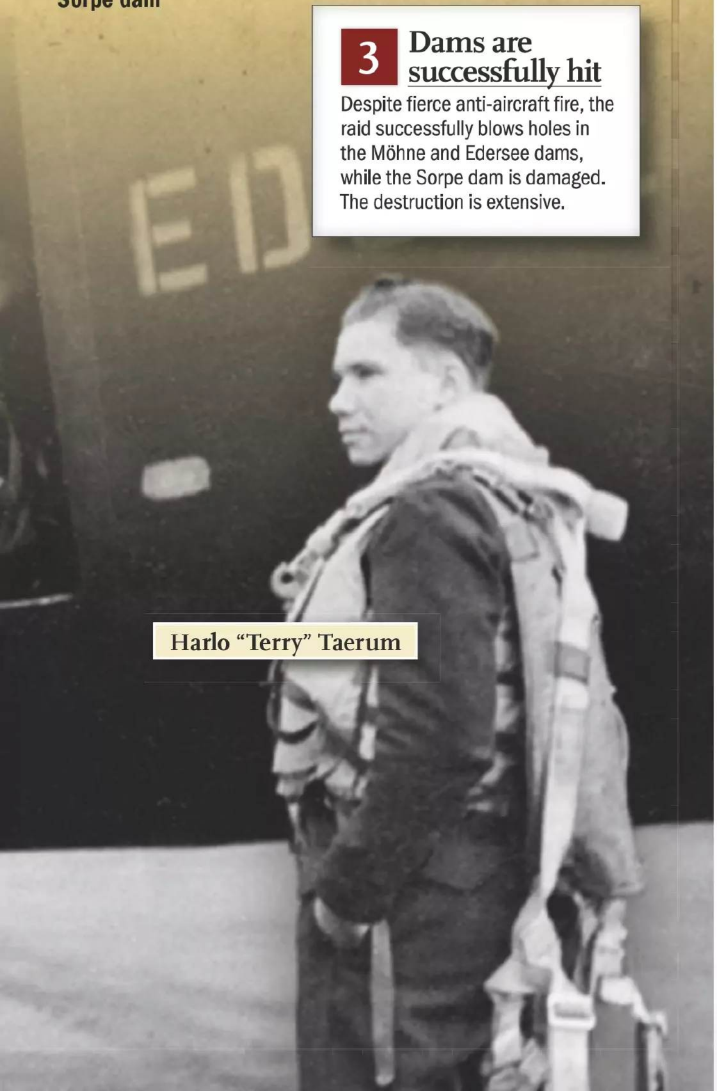
The seven crew members shown boarding the first bomber on the evening of 16th May, 1943.



The only aircraft beefy enough to carry the bombs were heavy Lancaster bombers.

3 Dams are successfully hit

Despite fierce anti-aircraft fire, the raid successfully blows holes in the Möhne and Edersee dams, while the Sorpe dam is damaged. The destruction is extensive.



Harlo "Terry" Taerum

were the only planes capable of transporting such heavy bombs. 19 aircraft were immediately set aside for extensive modifications, but months passed attempting to develop a special mount without success. Time became increasingly scarce, because the dams ought to be bombed in spring when the amount of water in the reservoirs was at its greatest.

PILOTS TRAINED IN ARTIFICIAL DARKNESS

Finally, in the early spring of 1943, the problems were apparently overcome. Even Bomber Command's Harris was convinced after several successful attempts. On 15th March, 1943, Harris ordered the creation of a whole new squadron. Initially named Squadron "X", 617 Squadron was led by Guy Gibson – he was just 24, but already an experienced pilot.

Ten days later, the squadron began training for the mission, now named "Operation Chastise". From morning to evening, men flew at low altitude across remote Welsh lakes. For security reasons, the crews had no idea what the mission entailed, but they soon realised it was something special.

Pilots and crew received no orders other than that the mission would take place at night. Training had to take place in daylight, however, so Wallis had the opportunity to assess the effect. To simulate darkness, crew members wore sunglasses during training flights, and the cockpit windows were tinted to add to the illusion.

PERFECT TIME APPROACHED

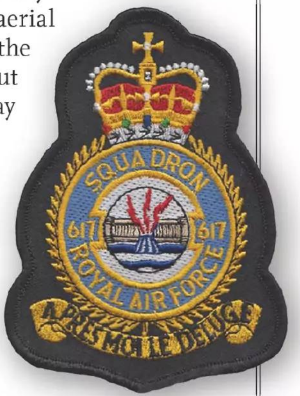
While 617 Squadron practiced flying low in Wales, British fighters performed reconnaissance at a 9 kilometre altitude. Here they were safe from both German planes and anti-aircraft guns. To prevent the Germans from smelling a rat, the planes' routes saw them fly over a wider area than simply the artificial lakes and dams of the Ruhr valley.

The pilots bought back sharp aerial photographs. The pictures showed that the lakes were filled to the brim, but preparations for the raid were a long way from complete.

The training was intensified and for practical reasons moved to Herne Bay in Kent – the very beach where the two boys lay in the grass and watched the bouncing bombs.

The testing of the bombs over open water did not go well, however. The bombs were still spherical, and several of the large planes were seriously damaged when they were hit by water from the exploding bombs. The aircrafts' tails were particularly exposed, and Squadron Leader Gibson reported that the crews barely survived the exercises.

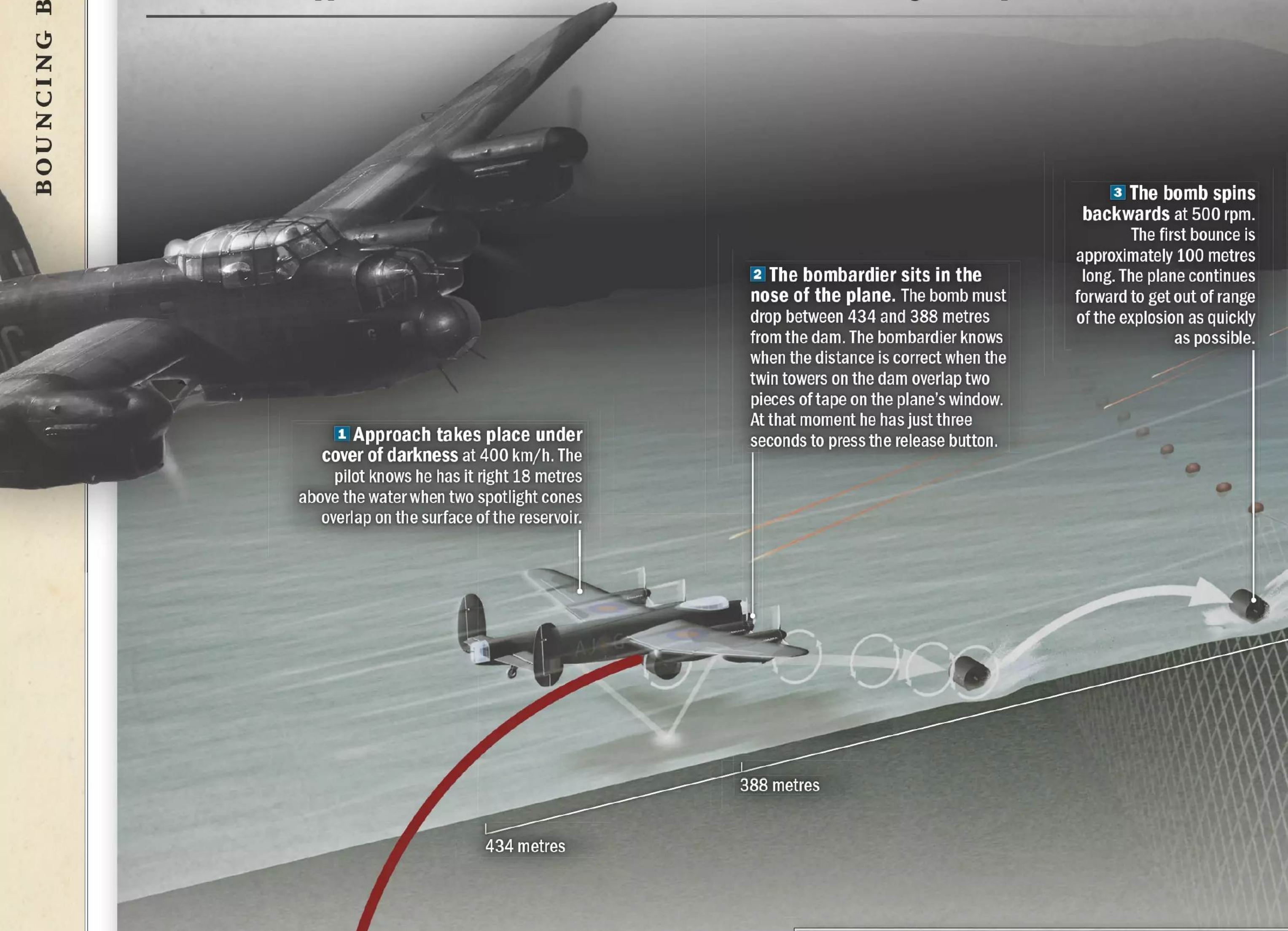
In an effort to improve safety, Wallis changed the bomb's shape from spherical to cylindrical. The design caused the bombs to skim more slowly over the surface of the



617 Squadron was established in 1943 and continued as a unit after the war.

Bombs hopped over torpedo nets

The dangerous mission was code named “Chastise”: to punish. Extreme accuracy was required: if the bomb wasn’t dropped within three seconds, it would either not reach the target or skip over the dam.



1 Approach takes place under cover of darkness at 400 km/h. The pilot knows he has it right 18 metres above the water when two spotlight cones overlap on the surface of the reservoir.

2 The bombardier sits in the nose of the plane. The bomb must drop between 434 and 388 metres from the dam. The bombardier knows when the distance is correct when the twin towers on the dam overlap two pieces of tape on the plane’s window. At that moment he has just three seconds to press the release button.

3 The bomb spins backwards at 500 rpm. The first bounce is approximately 100 metres long. The plane continues forward to get out of range of the explosion as quickly as possible.

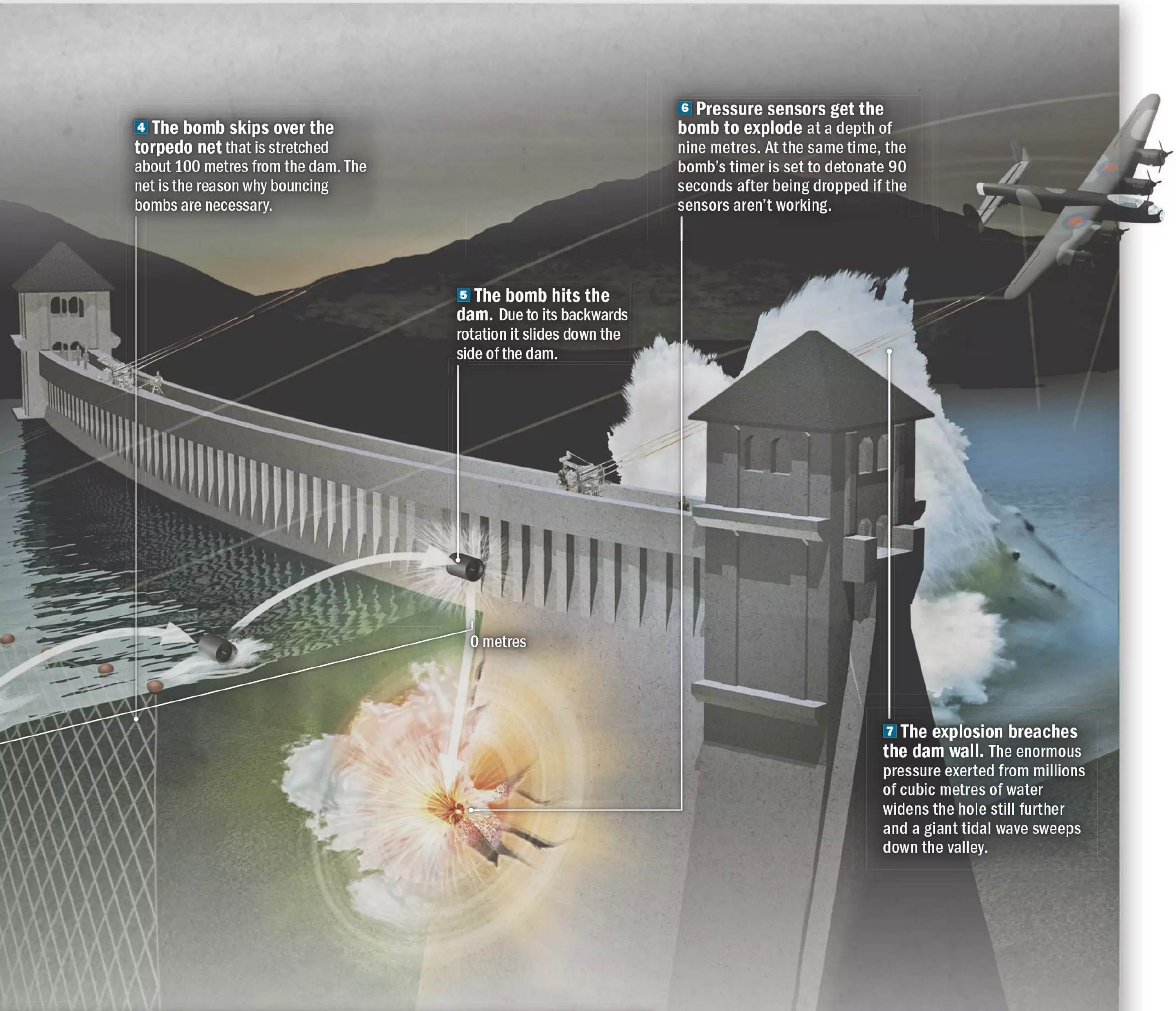
The bomb was shaped like a drum to help it skip over the water towards its target.

Motor set the bomb spinning

The bouncing bomb theory was one that no one believed in. Its creator Barnes Wallis code named it “Upkeep”, the name referring to the fact the bomb remained airborne thanks to its rotation.

2 The two V-shaped arms of the suspension swing out, and the bomb falls.

3 When it’s released, a wire is torn off and the bomb’s pressure sensors are automatically activated. The sensors control when the bomb is detonated.

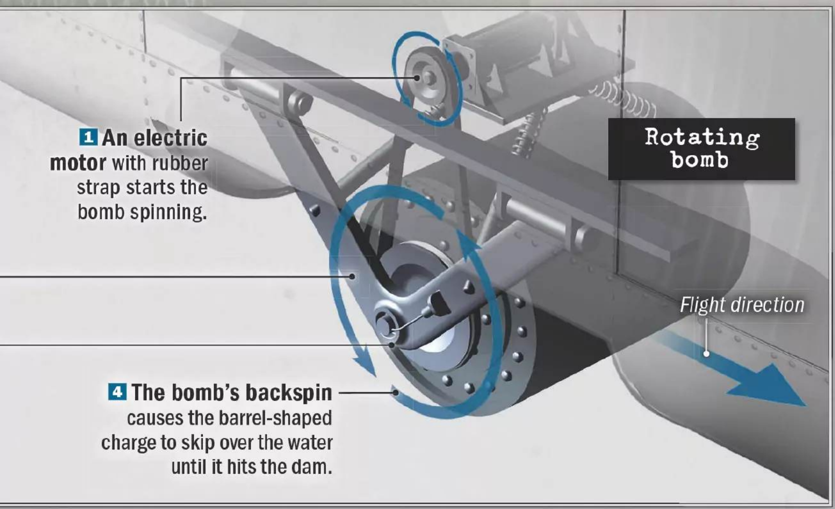


4 The bomb skips over the torpedo net that is stretched about 100 metres from the dam. The net is the reason why bouncing bombs are necessary.

5 The bomb hits the dam. Due to its backwards rotation it slides down the side of the dam.

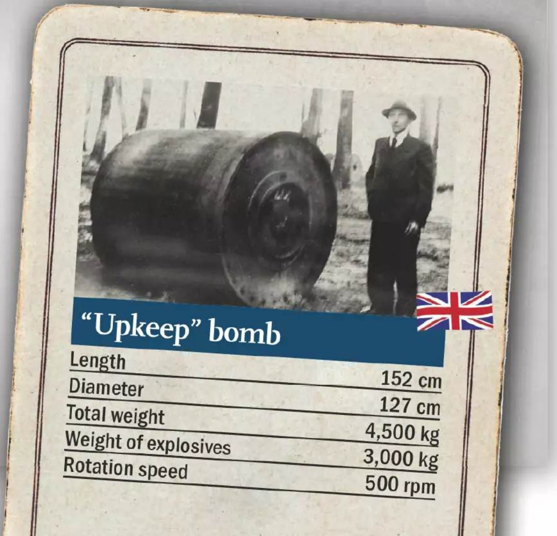
6 Pressure sensors get the bomb to explode at a depth of nine metres. At the same time, the bomb's timer is set to detonate 90 seconds after being dropped if the sensors aren't working.

7 The explosion breaches the dam wall. The enormous pressure exerted from millions of cubic metres of water widens the hole still further and a giant tidal wave sweeps down the valley.



1 An electric motor with rubber strap starts the bomb spinning.

4 The bomb's backspin causes the barrel-shaped charge to skip over the water until it hits the dam.



“Upkeep” bomb

Length	152 cm
Diameter	127 cm
Total weight	4,500 kg
Weight of explosives	3,000 kg
Rotation speed	500 rpm

water, so the planes could get away before the explosion occurred. Nevertheless, further problems remained: one plane dropped its bomb well before schedule, while another plane's mechanism for getting the bomb to rotate didn't work. At the same time, water levels behind the dams slowly sank as each day passed. The less water, the less damage the bombs could inflict.

Despite the setbacks, "Bomber" Harris decided to give the green light, and on the afternoon of 16th May, the crews were informed. Many were left shaken when they realised what their mission was and the risks involved, but there was no time for concern. Shortly afterwards, 19 Lancaster bombers were sent in three waves with Gibson captaining the front plane. The crews took two different routes across the North Sea with the express order to fly low to avoid enemy radar. One of the planes dipped so low its belly struck the water, the bomb was torn off and the captain forced to return to British shores.

The lack of altitude caused problems over land too. A total of five aircraft crashed after hitting buildings or electric pylons. Power lines in particular could tear a plane in half. Another plane had to turn back after it was hit by German anti-aircraft fire.

DAM APPEARED INVINCIBLE

When the squadron approached the Möhne dam, just 12 of the original 19 bombers were left. The anti-aircraft fire was intense, but Gibson began his attack nevertheless. The time was 00.20.

"As we came over the hill, we saw the Möhne lake. Then we saw the dam itself. In that light it looked squat and heavy and unconquerable", Gibson wrote afterwards.

The bomb from his plane was dropped, skimmed beautifully over the water, hit the dam and exploded below the surface. But it did not cause any visible damage to the massive concrete wall.

Instead of continuing straight on, Gibson pulled his plane off to one side as if he planned to return and attack again. The pilot hoped to draw much of the German anti-aircraft fire on to him and away from the next four bombers when they in turn flew low over the lake and dropped their bouncing bombs. His tactics were a complete success.

Despite this, none of the next three bombs secured full hits. One bounced to such an extent that it leaped over the dam and exploded over the power plant on the other side. At the same time, the plane was shot down. But seconds later came redemption. The fourth bomb burst the huge concrete structure and millions of tons of water poured through the hole, which widened as the pressure increased.

With Gibson in the lead, the remaining planes flew on to the Edersee dam, 10 minutes away. Here there were neither barrage balloons nor anti-aircraft guns, but the dam was in a narrow valley and it took several attempts to blow a hole in it. The third dam at Sorpe proved more robust. Although one of the bombs exploded right next to the dam, the damage was limited.

The trip home took place without any complications. The last plane landed at Scampton Airfield at 06.15, eight hours after starting.

It was only at the debriefing that the survivors discovered the true cost of the operation: of the 133 men who set out, only 77 returned. It was later discovered that 53 perished and three were taken prisoner. The youngest of the dead was Jack Liddell, just 18 years old. 11 out of 19 aircraft returned, but despite the losses, Bomber Command viewed the mission as a success, with two out of the three dams destroyed.

Even though neither headquarters nor the surviving pilots knew how serious the damage was, the RAF nevertheless issued a brief telegram about the operation. In the morning

Flying hero went to United States on lecture tour

The leader of Operation Chastise became a popular hero in both Britain and the US after the raid, but did not survive to the end of the war.

Two days after the raid, Britain's newspaper pages were filled with the story of its incredible success. The RAF enjoyed the attention and were happy to provide maps and aerial photos for editors all over the country.

The operation's biggest hero was Wing Commander Guy Gibson. Although Gibson was only 24 years old when he led 617 Squadron across Germany, he was already a experienced pilot with 172 missions behind him.

After Operation Chastise, Gibson received the Victoria Cross and accompanied Churchill on a trip to the US where he gave a series of lectures. Gibson also wrote a book and was briefly a Conservative Party candidate for Macclesfield before dying in a plane crash in 1944.

Guy Gibson
George VI

George VI was enthusiastic about the action and was subsequently briefed personally by Gibson.

of 17th May, 1943, the British public heard of Operation Chastise for the first time from the BBC.

The next day, a single Spitfire flew across Germany and photographed the destruction. The pilot Jerry Fray was shocked when he saw the sun shining on huge floods in the river valley of the Ruhr district. A few hours later he had landed back in England, and the photos were immediately developed. The evidence left no doubt: the damage was extensive as 330 million tons of water had washed away bridges and left several towns underwater. Several factories had been put out of action and an entire railway line had been washed away.

The raid proved a nightmare for the Germans. A wall of water several metres high had thundered down the valleys, carrying everything with it, including many forced labourers from the Soviet Union.

The Möhne dam was quickly repaired, while the Edersee dam was rebuilt after the war. But first and foremost, the attack had been a propaganda victory, which demonstrated to the world that the Allies could hit the Germans anywhere.

PERSPECTIVE

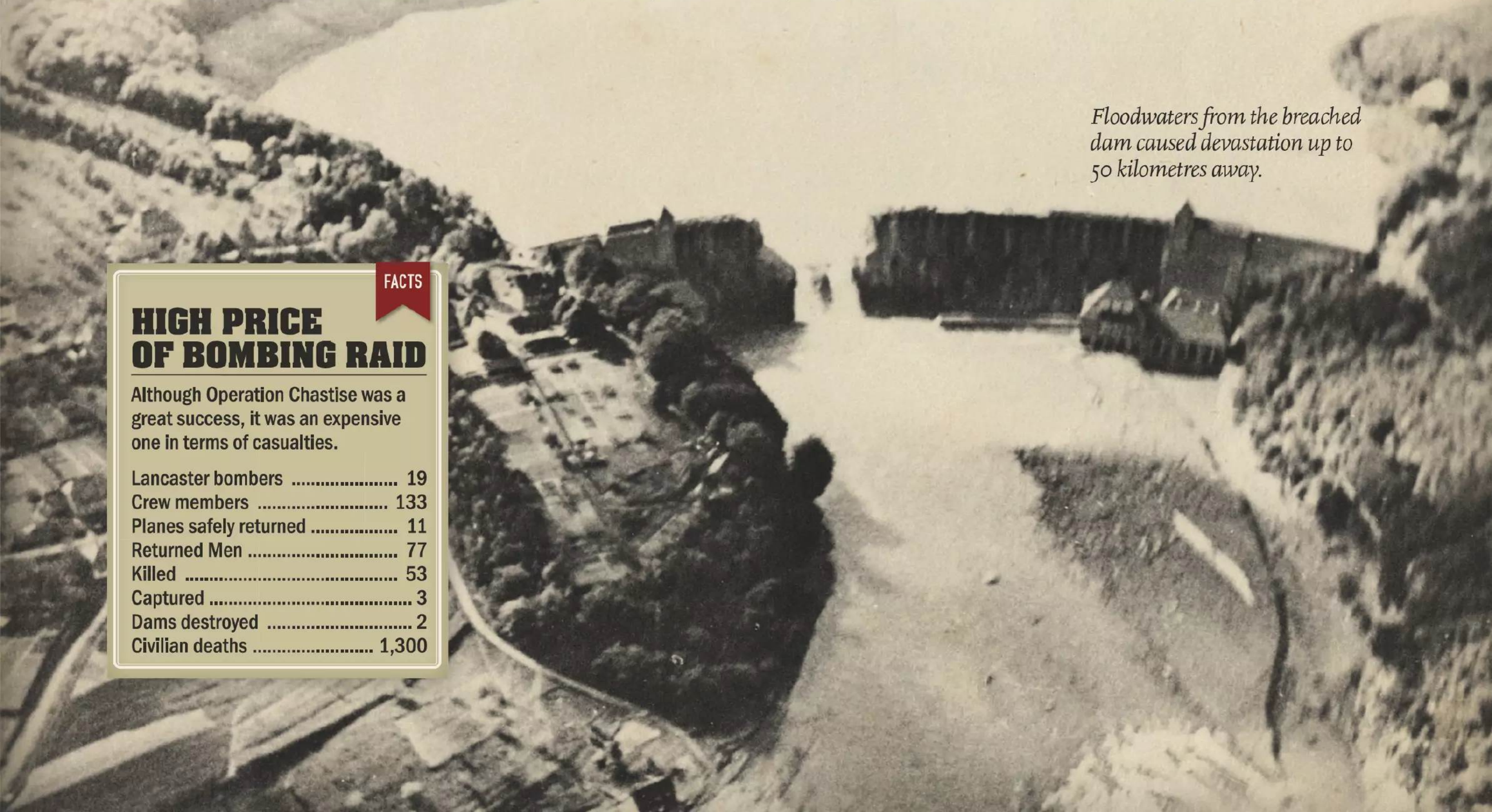
Bombing raid severely disrupted Nazi war machine

The Germans immediately started rebuilding the destroyed dams, but the repair work was difficult, and it wasn't until September that the damage was mostly repaired. The Ruhr district's arms factories had lacked a power source all summer, and much precious time had been lost.

The Ruhr dams played a crucial role in the German war effort, so the Nazi regime wasted no time in starting to rebuild them. An army of forced labour, mostly from Eastern Europe, was brought in and forced to work around the clock.

It wasn't simply the dams themselves that were damaged. All bridges 50 kilometres or less downstream of the Möhne dam were also destroyed by the pressure of the tidal wave, and the flow of water had also left a series of buildings in ruins. 12 factories that produced weapons and ammunition were completely destroyed, while 100 more were damaged. Coal production fell by around 400,000 tons in May compared to the previous month. Large agricultural areas were also destroyed through flooding. The Germans referred to the attack as the Möhne Disaster and even the usually unflappable armaments minister Albert Speer was allegedly shaken.

Reconstruction took around five months. A large proportion of the labour force were people who'd been earmarked to help strengthen Hitler's Atlantic Wall defences. The re-fortifications were delayed, giving the Allies an easier task landing on D-Day.



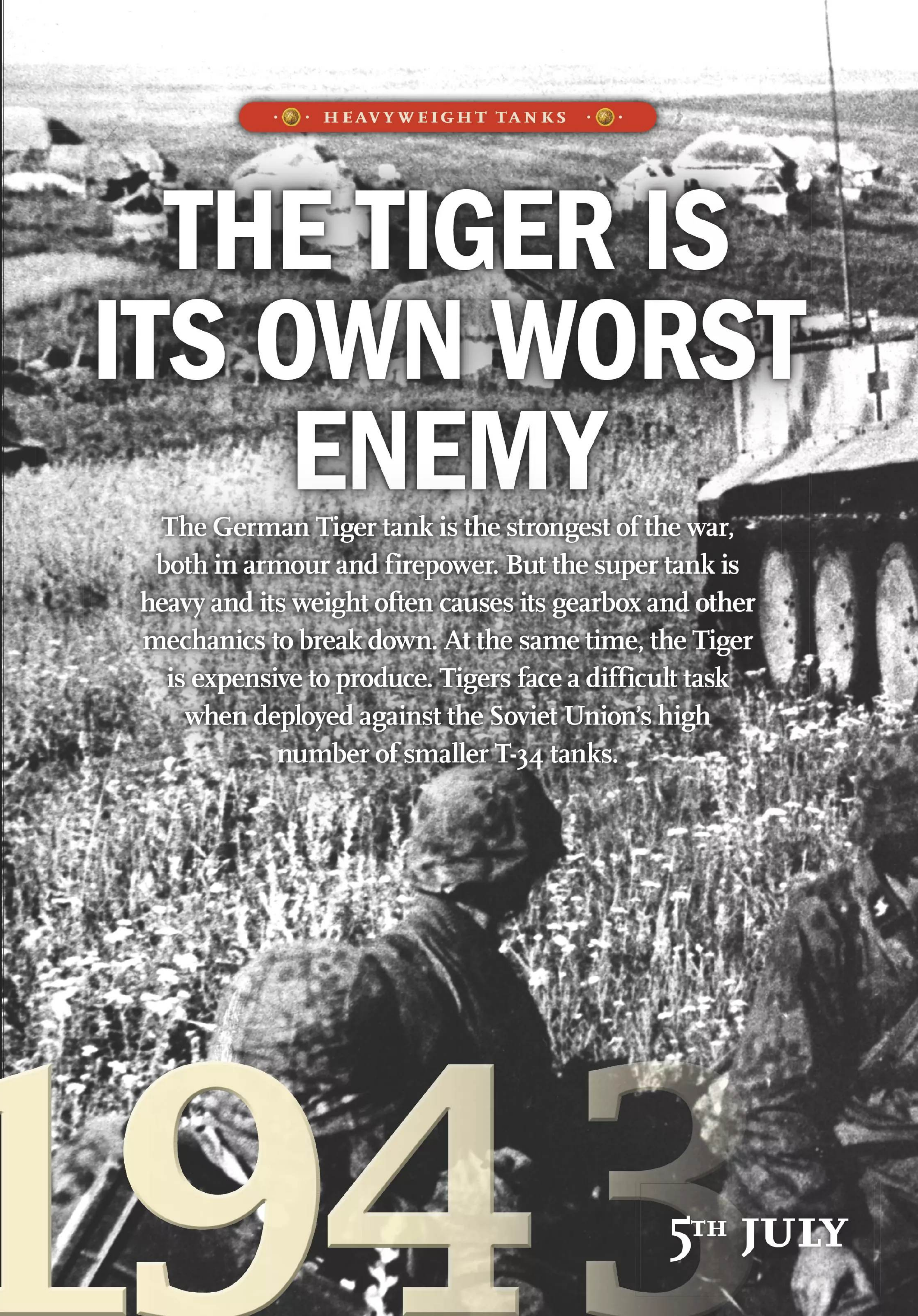
Floodwaters from the breached dam caused devastation up to 50 kilometres away.

FACTS

HIGH PRICE OF BOMBING RAID

Although Operation Chastise was a great success, it was an expensive one in terms of casualties.

Lancaster bombers	19
Crew members	133
Planes safely returned	11
Returned Men	77
Killed	53
Captured	3
Dams destroyed	2
Civilian deaths	1,300



THE TIGER IS ITS OWN WORST ENEMY

The German Tiger tank is the strongest of the war, both in armour and firepower. But the super tank is heavy and its weight often causes its gearbox and other mechanics to break down. At the same time, the Tiger is expensive to produce. Tigers face a difficult task when deployed against the Soviet Union's high number of smaller T-34 tanks.

1943

5TH JULY

German soldiers move forward in a Tiger I during Operation Citadel in the Soviet Union in July 1943.

Soviet Union, 1943

THE STAGE IS SET

SOVIET UNION

Tiger I tanks are being sent into the field on the Eastern Front. They must turn the fortunes of war in the Soviet Union after the Germans invaded in the summer of 1941 with tanks that are no match for the Russian T-34s. The Tiger may be a game changer: it can destroy T-34s before it comes within range of the Soviet tank.

THE EARTH SHOOK UNDER THE TANK'S TRACKS, while its commander SS-Untersturmführer Michael Wittmann chose his next target from his seat atop the tank's gun turret. As usual, the taciturn Wittmann issued short, precise orders like "Turn left", "Target 100 metres" and "Go!"

Around 2,000 German and Soviet tanks were convened together on the great plain south of the Russian city of Kursk. Fighting had been almost uninterrupted on this battlefield since it had started a week earlier on 5th July, 1943. It was the largest tank battle the world has ever seen, but Wittmann could feel reasonably secure in his armoured skin: for the first time the 28-year-old SS officer was in command of Germany's top tank, the Tiger I, in a major battle.

Despite the Tiger's heavy weight, it reacted quickly to any threat. Instead of spending half a minute turning the heavy gun turret, Wittmann could turn the entire tank around in a few seconds. The medium Soviet T-34 tanks didn't stand a chance. Eight tanks, three anti-tank guns and a gun battery soon fell to Wittmann's Tiger I. The battle's approximately 70 other Tigers also pounded more Russian combat vehicles.

As darkness fell, the Russian plains were covered with charred bodies, and black columns of oily smoke rose from hundreds of burning wrecks. About 700 tanks had been shot to pieces.

Most were Soviet and German medium-sized tanks, but the Germans – despite losing the battle at Kursk – had not lost many Tigers. Also, Wittmann would be returning to his division, having just

1914-1944

NAME **MICHAEL WITTMANN**

TITLE TIGER COMMANDER

Ace destroyed 138 tanks

Michael Wittmann was one of Germany's best Tiger commanders, and during the war he was noted for the destruction of no less than 138 Allied tanks, 132 anti-tank guns and a number of anti-tank vehicles. In battle for the French town of Villers-Bocage with British forces, he hit 14 tanks, 15 trucks and two anti-tank guns on his own in the space of just 15 minutes.

The propaganda machine in Germany made great use of Wittmann, and the Bavarian-born SS soldier was portrayed as a hero. He was part of the Leibstandarte SS Adolf Hitler division that took part in the annexation of Austria and the Sudetenland. In the spring of 1941 he was assigned to the SS Panzer Regiment 1, commanding small tanks. By 1943 he was in command of Tiger 007 at the Battle of Kursk.

In 1944 Michael Wittmann's unit moved to Northern France to counter the Allied invasion. Here, the famed Tiger Commander and SS-Hauptsturmführer became a victim of a British tank strike on 8th August, 1944.

- **Received the Knight's Cross with Oak Leaves and Swords.**
- **Married five months before his death.**

made his name as the Nazi's undisputed champion tank commander. A large part of his success could be attributed to the Tiger, however, which had proved to be a formidable weapon since its introduction in 1942.

A 60-tonne Tiger I tank drives straight through houses in its path.

New ammunition is loaded on board. The tank's armament included 92 armour-piercing shells.

T-34 COULD NOT RETALIATE

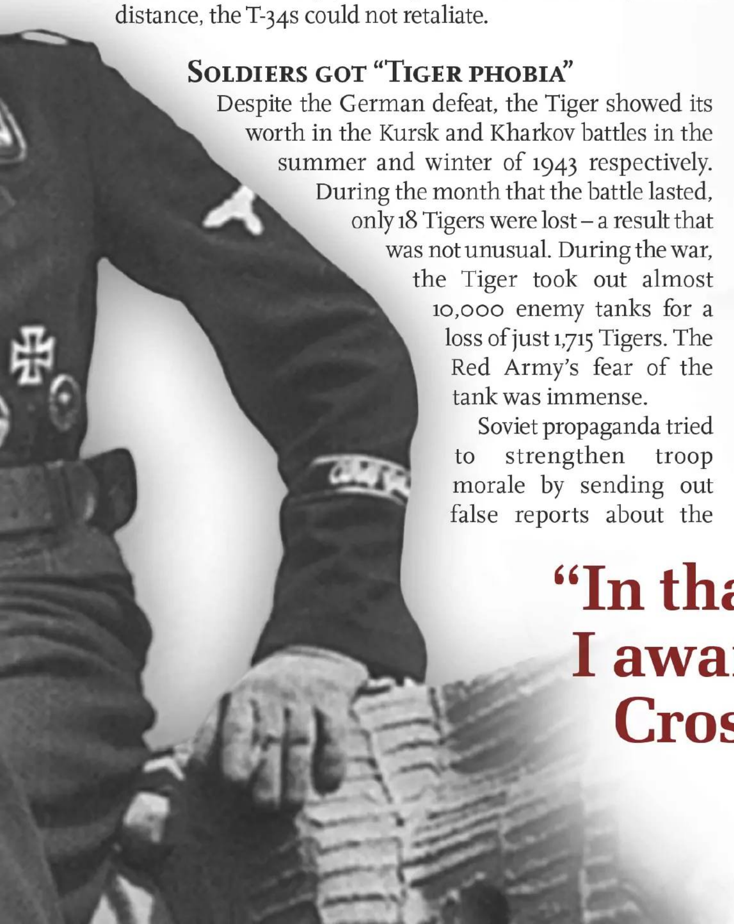
By May 1941, Hitler had already ordered the military vehicles. He demanded strong armour, huge firepower and a waterproof hull with snorkel equipment, so the tank could cross the many rivers in France and the Soviet Union without problems.

While engineers worked on the tank, Hitler sent the German army into the Soviet Union in June 1941. The Wehrmacht countered any resistance and quickly occupied large areas of land, yet on one side, Hitler's army met unexpectedly stiff resistance: the Soviet T-34 tanks were far superior to the German Panzer and Panther models.

After almost a year – where the military vehicles' deficiencies had been exposed time and again – German engineers were able to give the armoured divisions some good news: the first Tiger I was ready. The Germans began training officers to serve on the advanced super tank immediately.

The new weapon was built for its firepower and impervious armour. With massive ammunition and fuel storage the giant weighed up to 60 tonnes. Nevertheless, it was not much slower than its enemies: in uneven terrain it could thunder at 20 km/h. Its top speed was twice that figure.

In autumn 1942 the Tigers were sent to the Eastern Front, and the Red Army quickly learned to fear its powerful 88-mm guns. In the right weather condition, a Tiger I could totally annihilate a Soviet T-34 from up to 2,200 metres away. At that distance, the T-34s could not retaliate.



SOLDIERS GOT "TIGER PHOBIA"

Despite the German defeat, the Tiger showed its worth in the Kursk and Kharkov battles in the summer and winter of 1943 respectively. During the month that the battle lasted, only 18 Tigers were lost – a result that was not unusual. During the war, the Tiger took out almost 10,000 enemy tanks for a loss of just 1,715 Tigers. The Red Army's fear of the tank was immense.

Soviet propaganda tried to strengthen troop morale by sending out false reports about the vulnerability of the Tigers. In the summer of 1943 the Soviet Union proclaimed that the Red Army defeated 10-12 Tigers a day.

The propaganda soon became so unrealistic that, after a couple of weeks, the Soviet Union claimed to have destroyed more Tigers than actually existed.

However, the Soviet's attempt to make Hitler's tank seem less fearsome didn't have much effect. Just the rumour that Tigers waited ahead was enough to spread terror through the Red Army.

The Allies experienced a similar fear among its soldiers, which the British came to dub "Tiger phobia". In an attempt to curb his soldiers' fear of the superweapon, Field Marshal Bernard Montgomery forbade his officers to talk about the Tiger with the rank-and-file soldiers.

Several German tank commanders had also demonstrated that the enemy was wise to fear a Tiger I. For example, Wittmann defeated 117 enemy tanks during his seven first months as a Tiger commander.

THE ENEMY NEVER CAME WITHIN RANGE

Germany's famous tank divisions came to battle once again when 33 Soviet tanks broke through German lines in Ukraine on the morning of 8th January, 1944.

Wittmann turned up immediately. The now 29-year-old SS officer had 12 Tiger tanks under his command. Crackling machine guns, cannons and engine noise resonated over the snowy fields, but on this icy morning, low-lying fog prevented him from seeing far ahead. Suddenly, the enemy's tanks appeared in the ghost-like landscape. Wittmann »

> **"In thankful appreciation… I award you… the Knight's Cross of the Iron Cross"**
>
> Adolf Hitler to Michael Wittman in January 1944

"Hit somebody with your fist and not with your fingers spread"

Heinz Guderian, German general and tank commander

determined their position, and the gunner set the Tiger's 88-mm cannon. A shell blew up the turret of the first T-34.

Several other tanks had appeared in the meantime, and Wittmann had a myriad of targets to choose from. He created a furious wall of fire. A shell hammered into a T-34, which was about launch its weapon on the German battalion. Shortly after, Wittmann's Tiger set its sights on another enemy tank. The unit's fire overwhelmed the Soviet invaders, who hesitated – fatally. The Germans surrounded their tanks in a pincer movement, and four hours later they were defeated. 33 T-34s and seven guns were either out of action or in flames.

Once again, the Tiger had demonstrated its superiority against the Russian T-34s, which had less armour and a shorter range of fire. The Russians had to get within 1,600

The great German Tiger tank storms through the battlefield between the smaller Russian T-34s.

metres of a Tiger to destroy it, while the Tiger could promptly hit a T-34 from a distance of 2,200 metres.

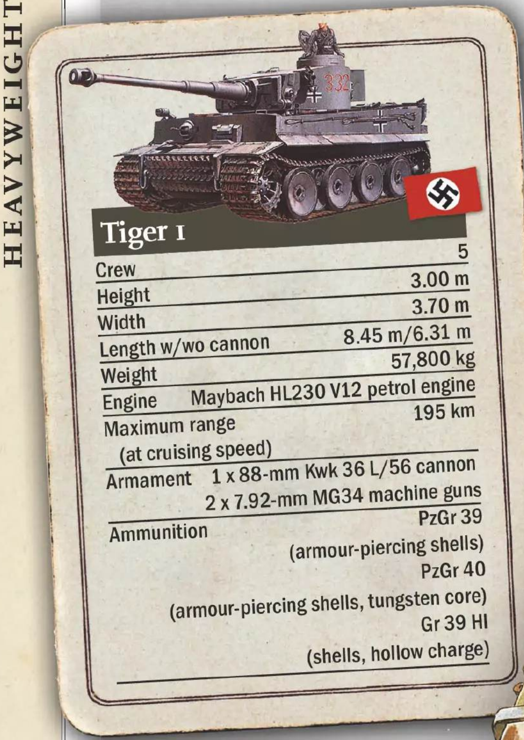
Tiger was too expensive too operate

But the Tiger's success was not enough to turn the fortune of war Hitler's way, and ironically it didn't help when in the summer of 1944 German engineers delivered the first improved version of the victorious super tank to the army: Tiger II, which was also dubbed the King.

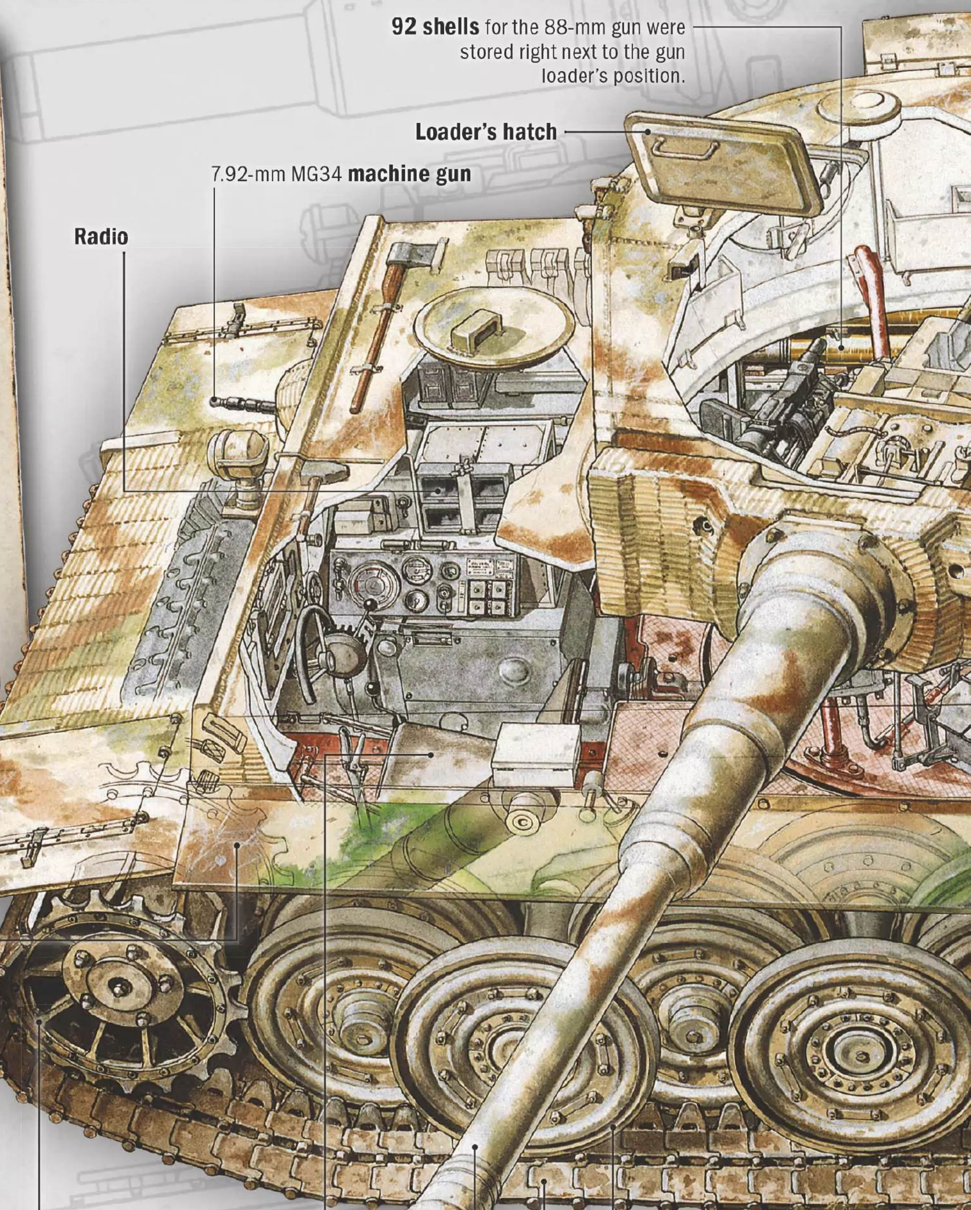
The German army was now constantly retreating in winter-cold Eastern Europe – something the Tiger wasn't designed for. It already consumed huge amounts of fuel – 15 litres per kilometre driven – so in high snow or deep mud the demanding engine burned even more.

Tiger was a born killer

The German company Henschel & Sohn produced 1,347 Tiger I tanks. They were all equipped with the most advanced technology that Nazi Germany could provide.



Tiger I	
Crew	5
Height	3.00 m
Width	3.70 m
Length w/wo cannon	8.45 m/6.31 m
Weight	57,800 kg
Engine	Maybach HL230 V12 petrol engine
Maximum range (at cruising speed)	195 km
Armament	1 x 88-mm Kwk 36 L/56 cannon 2 x 7.92-mm MG34 machine guns
Ammunition	PzGr 39 (armour-piercing shells) PzGr 40 (armour-piercing shells, tungsten core) Gr 39 HI (shells, hollow charge)



92 shells for the 88-mm gun were stored right next to the gun loader's position.

Loader's hatch
7.92-mm MG34 **machine gun**
Radio

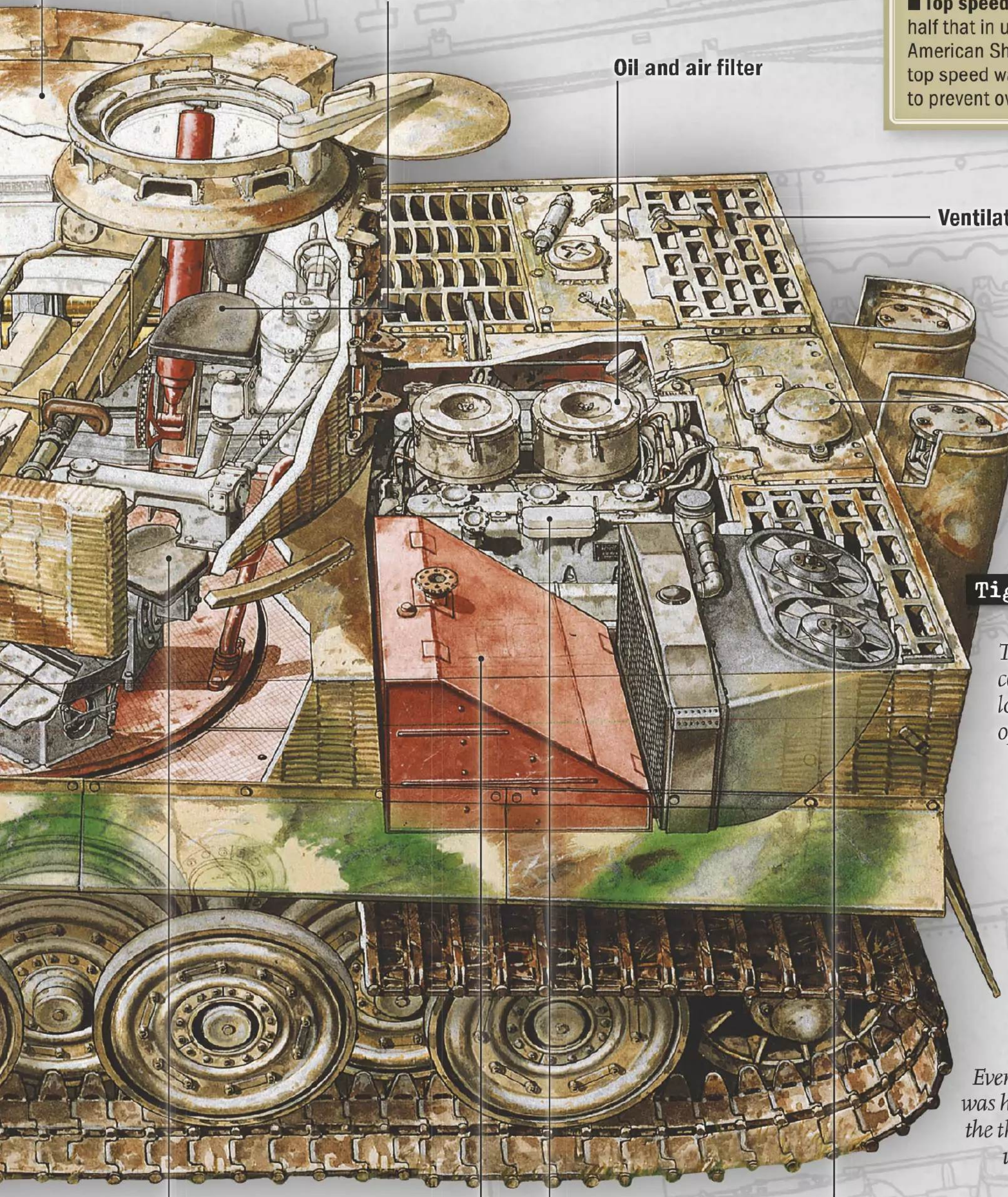
From September 1943, engineers covered the Tigers with a non-magnetic anti-mine coating **(Zimmerit)**.

Driver's seat
Gunner's seat
Shock absorber
Rubber-padded steel deck
88-mm Kwk 36 L/56 **cannon**

The **caterpillar tracks** were extremely wide. The belts, measuring 72.5 cm, ensured that the heavy tank did not get hopelessly stuck in the mud.

With a little luck, a hand grenade could be slipped into a gun barrel.

The turret weighed 11 tonnes and rotated very slowly – it took about a minute to turn 360 degrees. It was actually quicker to turn the whole tank.



The snorkel and watertight hull allowed the Tiger to ford rivers 4.5 metres deep. Only the first 495 Tigers were equipped with snorkels.

The engine was perfect for a lighter tank, but barely sufficient for the Tiger's weight. After 250 had been built, the engine was upgraded.

Tiger I

The crew consisted of a commander, gunner, loader, driver and radio operator.

FACTS

EASY TO ROTATE

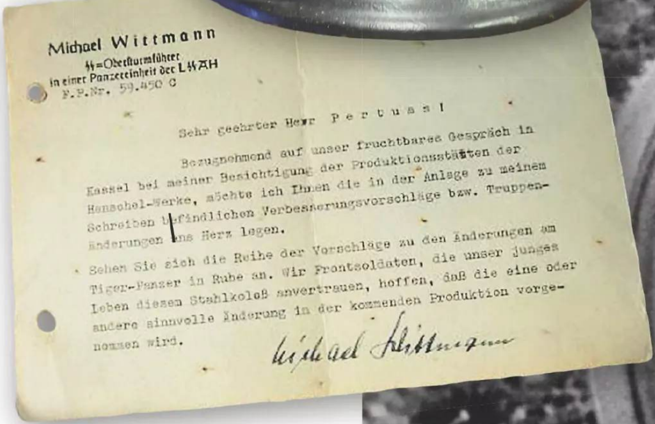
- **The hydraulic steering system** meant that the caterpillar tracks could drive each way, and the Tiger could turn on its axis in just 3.44 metres.
- **Top speed** was 45.4 kilometres per hour and about half that in uneven terrain. The Soviet T-34 and the American Sherman were only slightly faster. The Tiger's top speed was later reduced to 38 kilometres per hour to prevent overloading the engines and gears.

Even if the Tiger was hit by a shell, the thick armour usually held.

The Tiger's efficient 88-mm gun was the same type used by anti-aircraft units.

"Tigers and Panthers don't eat hay", exclaimed a German officer despairingly in the winter of 1944. Another problem was the weight of the tanks, which tested the Tiger's suspension, gearbox and other vital parts to the extreme. Uneven terrain, high speeds or long stretches often caused the mechanics to break completely. In fact, a Tiger tank rarely managed a long march without breaking down.

The mechanical problems were a big deal for the Germans, and it was not long before the Allies discovered their weaknesses. For example, in the summer of 1944 British soldiers found some broken-down Tigers in Italy. The discovery caused quite a stir among British Army commanders, who had been looking for a way to defeat the tank. They set up a group to investigate the tanks, and in August they came to a somewhat surprising conclusion in the report "Who killed the Tiger?" It killed itself.



Michael Wittmann
ϟϟ=Obersturmführer
in einer Panzereinheit der LϟϟAH
F.P.Nr. 59.450 C

Sehr geehrter Herr P e r t u s s !

Bezugnehmend auf unser fruchtbares Gespräch in Kassel bei meiner Besichtigung der Produktionsstätten der Henschel-Werke, möchte ich Ihnen die in der Anlage zu meinem Schreiben befindlichen Verbesserungsvorschläge bzw. Truppenänderungen ans Herz legen.

Sehen Sie sich die Reihe der Vorschläge zu den Änderungen am Tiger-Panzer in Ruhe an. Wir Frontsoldaten, die unser junges Leben diesen Stahlkoloß anvertrauen, hoffen, daß die eine oder andere sinnvolle Änderung in der kommenden Produktion vorgenommen wird.

Michael Wittmann

Michael Wittmann wrote a letter to the Henschel plant with suggestions for improvements of the Tiger.

The Wehrmacht had spent years trying to keep the Tiger's technical problems secret. But the mechanics were a constant headache for the tank drivers. For example, they had to lift the 11-tonne turret with a crane to replace the gearbox. In addition, there didn't have to be much frost on the Eastern Front's slippery roads before the mud froze between the wheels. Often the crew had to remove the massive wheels to scrape them free of ice. Such repairs were time-consuming and awkward in perfect conditions. On an ice-cold and muddy battlefield, the task was almost impossible. Many Tiger drivers had to reluctantly blow up their valuable tanks and walk away on foot, so the enemy wouldn't get hold of them.

The problems led to the German tank battalions never having the luxury of enough combat-ready Tigers to strike a decisive blow. At the same time, they were hampered by a lack of skilled commanders. Therefore, young and inexperienced officers were often given command of a Tiger with the message: "Be careful, you've got a million marks and »

"The engine of the Panzer is a weapon just as the main-gun"

Heinz Guderian, German general and tank commander

In a break in the midst of war, a Tiger radio operator makes sandwiches for himself and his comrades.

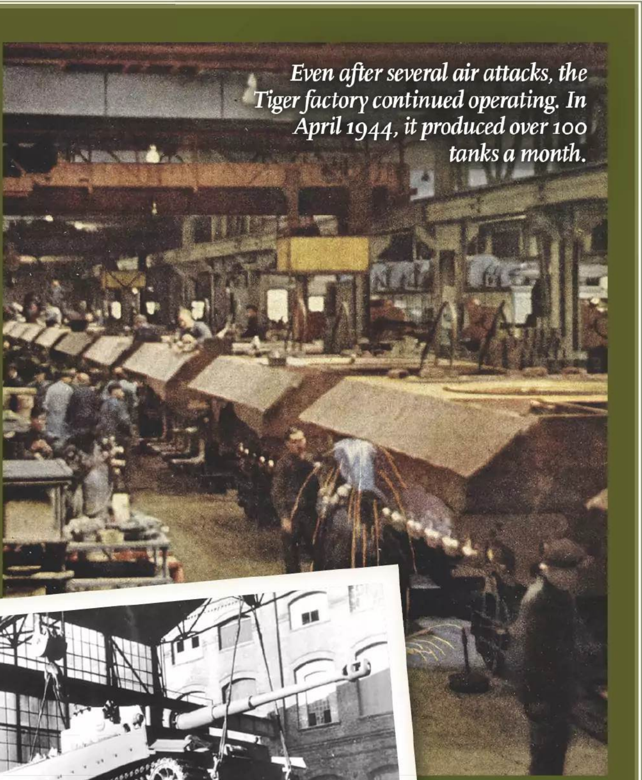
Factory supplied tanks to the end

The city of Kassel was the centre of Tiger production. The German arms manufacturer Henschel & Sohn built tanks until April 1945.

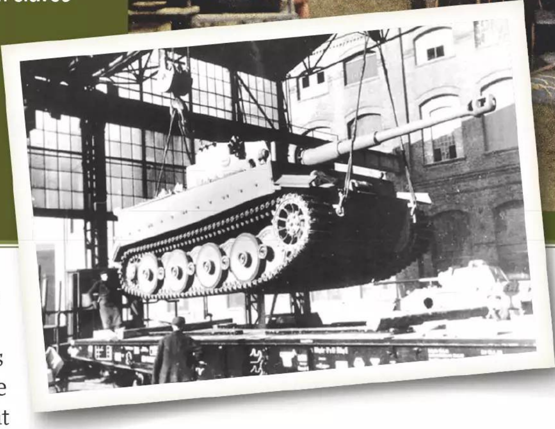
The Tiger was so packed with advanced mechanics that Henschel & Sohn factory in Kassel took 300,000 man hours constructing a single tank. This was double the production time of other German tanks.

In 1942, the Kassel plant only produced about 25 units a month, which failed to cover the German Army's demand. Therefore, the factory had to switch to manufacturing seven days a week, and in April 1944 it produced over 100 Tigers a month. More than 8,000 men were in work and many of them were Jewish slaves who were worked to death.

On 1st April, 1945, the American army reached Kassel, but Henschel & Sohn continued undeterred and delivered 13 Tigers the same day to two German companies. On 4th April, the Americans finally captured Kassel and production stopped forever.



Even after several air attacks, the Tiger factory continued operating. In April 1944, it produced over 100 tanks a month.



A finished Tiger is loaded on a railway car in Kassel in 1942.

three and a half million working hours under your arse".

The men's inexperience resulted in many Tigers simply breaking down because they were overloaded. Often they did not even reach the front before they broke down. Fortunately for the Nazis, a significant number of tank commanders weren't incompetent. Wittmann destroyed a total of 138 enemy tanks – but even his luck couldn't hold forever.

WITTMANN DIED WITH THE TIGER

In 1944 Wittmann was sent to north-western France, where on 8th August, 1944 the Allies launched a major offensive.

Wittmann went to help the German soldiers against the superior force they faced, but after only one hour of battle his Tiger was in flames. When the tank exploded from the inside, the pressure was so violent that the 11-tonne turret was blown off.

The great Nazi hero died together with his men, and his death sent shock waves through the battalion.

Most battle-ready Tigers were wrecked over the following month. Some were destroyed by fierce shelling, but a great many were blown to pieces by the German army. Spare parts and fuel were now impossible to come by, and the Germans refused to let the precious tanks fall into enemy hands.

THE TIGER II ARRIVED TOO LATE

Neither could the Tiger II reverse the war for the Germans. The updated version of the Tiger was as difficult to produce as its predecessor, and Henschel & Sohn only built 492 Tiger IIs. They were too few to have a decisive influence on the war.

The Tiger II was first put into service in July 1944, and was reputedly used during combat in Normandy, where Allied troops began their liberation of Europe. On the Eastern Front, Tiger II first participated in sorties in August of the same year – far too late to stop the Soviets' rapid advance.

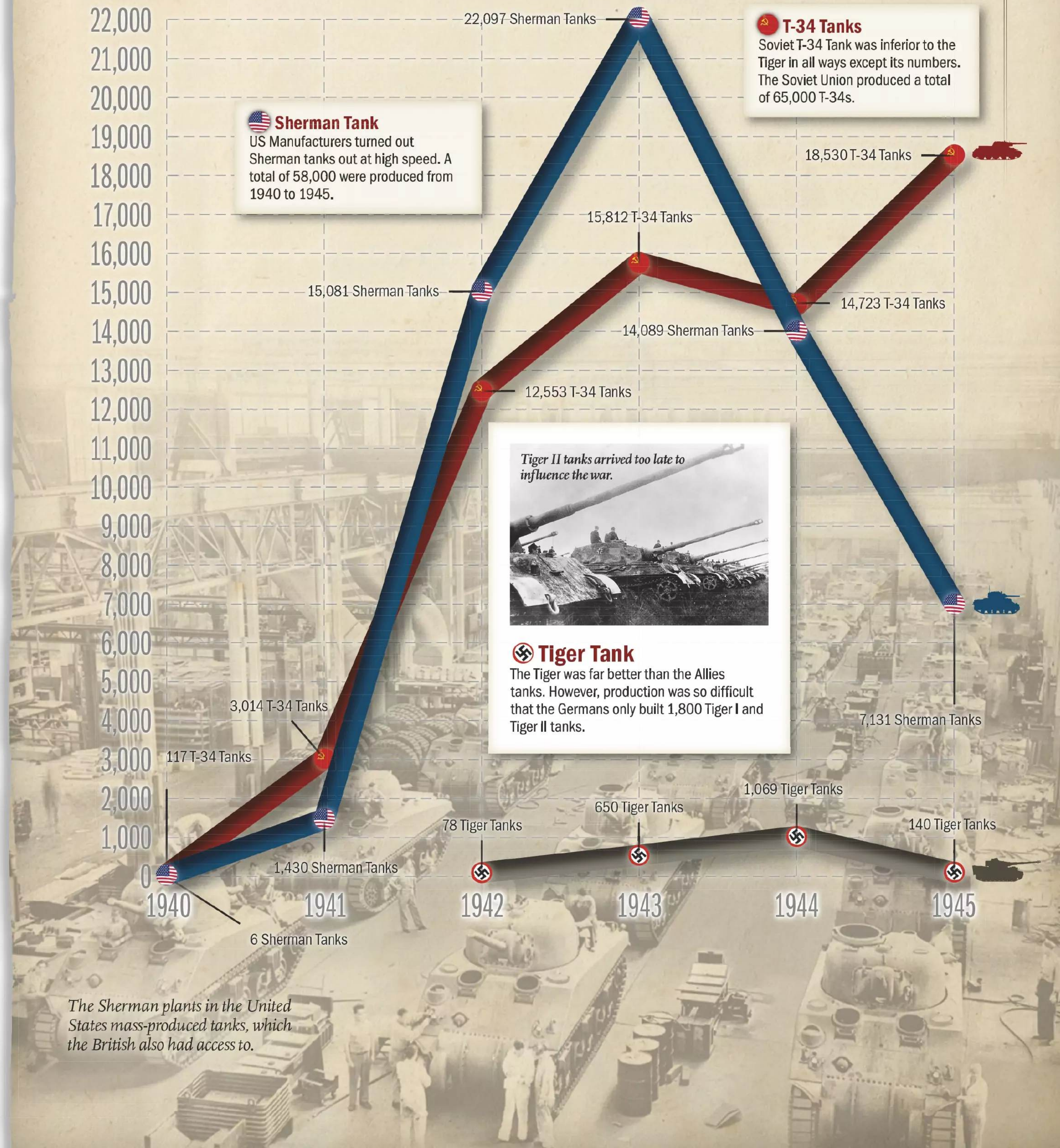
When Nazi Germany finally surrendered in 1945, the few remaining Tigers were shown to have no value for the Allies – they required too many expensive spare parts. Therefore, Tiger production never resumed – despite its superior strength.

> **"He was a fighter in every way, he lived and breathed action"**
>
> SS-Obergruppenführer Josef "Sepp" Dietrich after Michael Wittmann's death

Greater numbers won over size

Every Tiger wiped out an average of 5.74 enemy tanks. But the tank couldn't turn the war when the United States and the Soviet Union built up a combined total of 123,000 Sherman and T-34 tanks to counter the 1,800 German Tigers.

Michael Wittmann received a series of honours for his kills as Tiger commander.



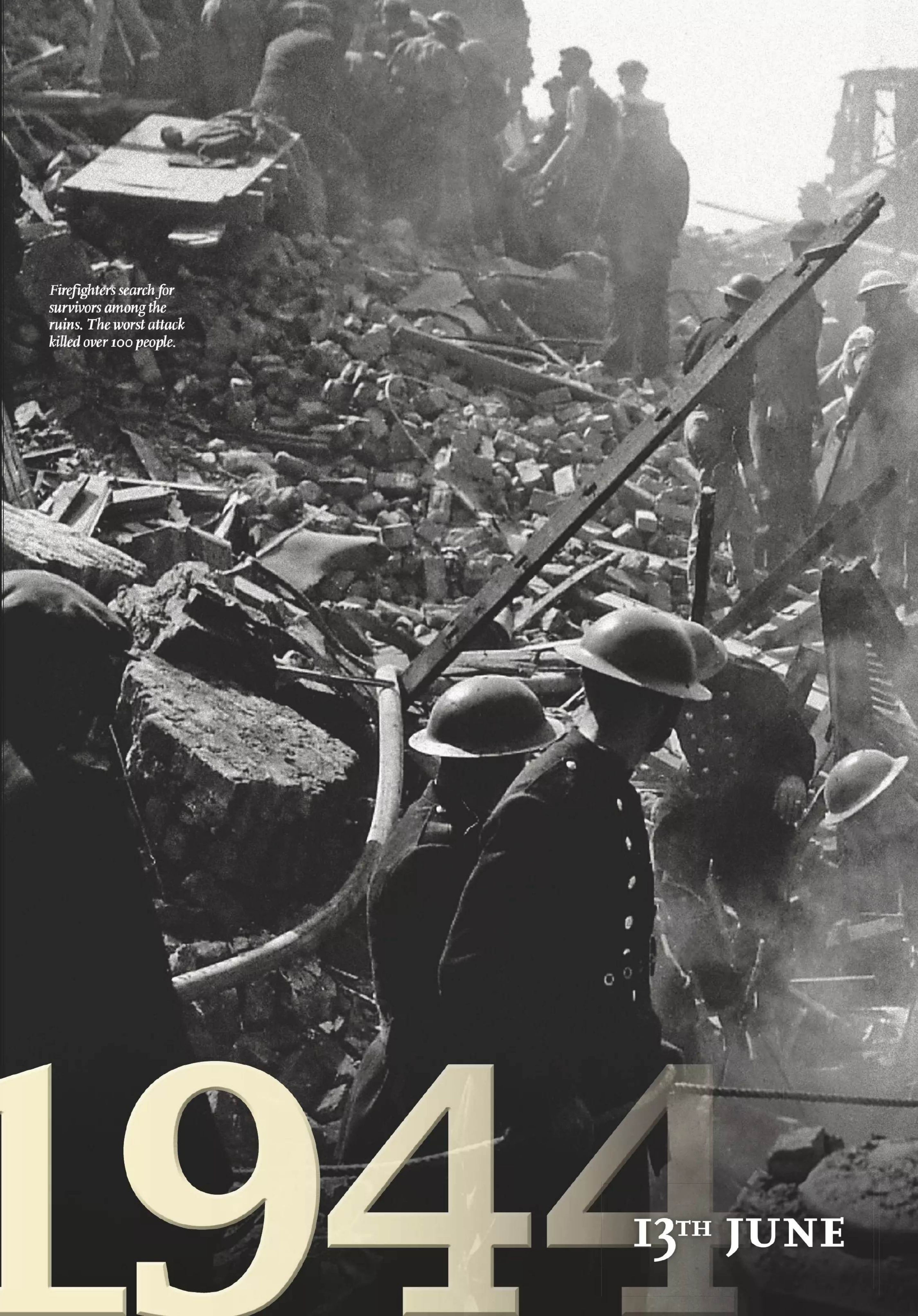
Sherman Tank
US Manufacturers turned out Sherman tanks out at high speed. A total of 58,000 were produced from 1940 to 1945.

T-34 Tanks
Soviet T-34 Tank was inferior to the Tiger in all ways except its numbers. The Soviet Union produced a total of 65,000 T-34s.

Tiger II tanks arrived too late to influence the war.

Tiger Tank
The Tiger was far better than the Allies tanks. However, production was so difficult that the Germans only built 1,800 Tiger I and Tiger II tanks.

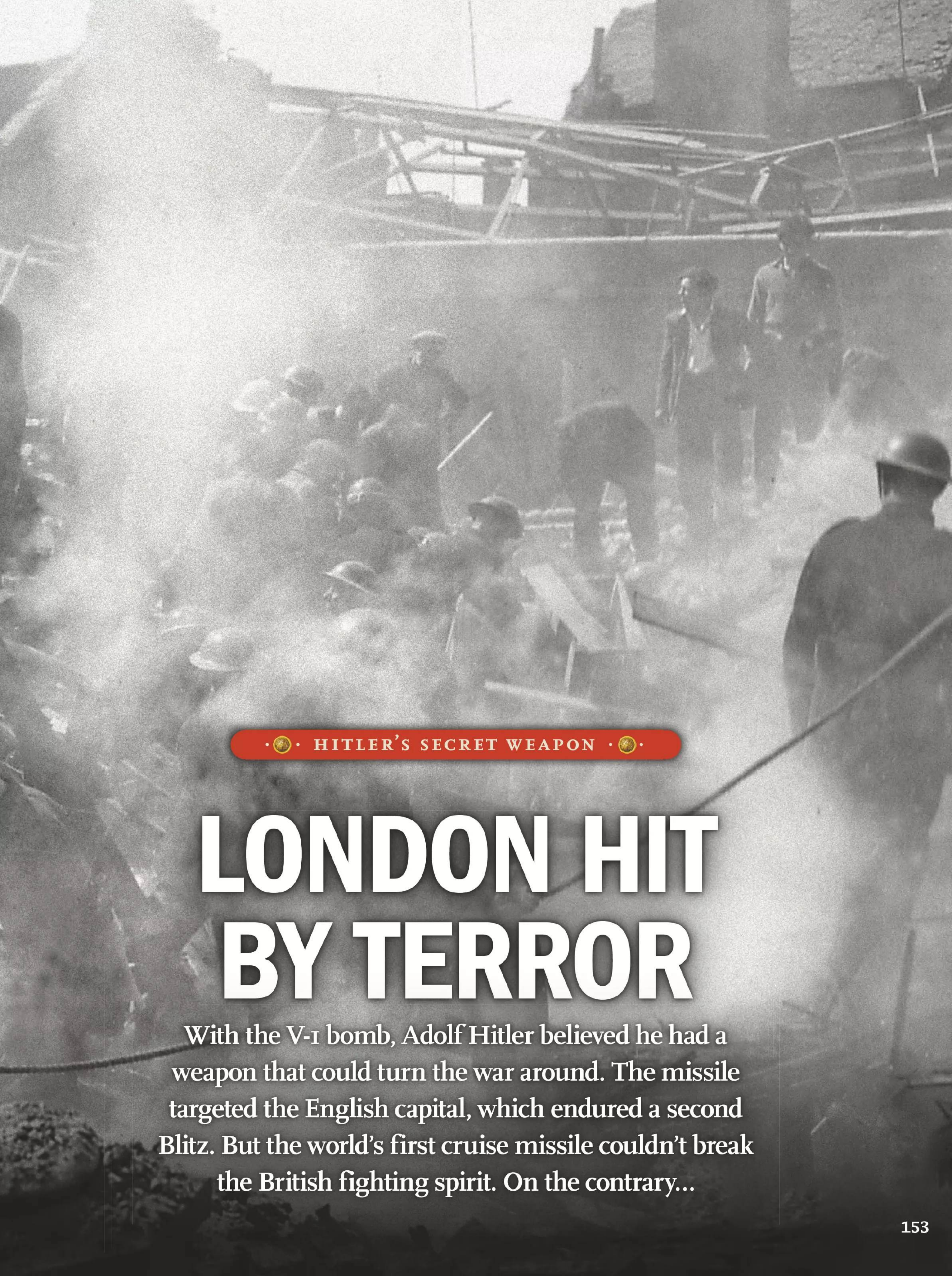
The Sherman plants in the United States mass-produced tanks, which the British also had access to.



Firefighters search for survivors among the ruins. The worst attack killed over 100 people.

1944

13TH JUNE



HITLER'S SECRET WEAPON

LONDON HIT BY TERROR

With the V-1 bomb, Adolf Hitler believed he had a weapon that could turn the war around. The missile targeted the English capital, which endured a second Blitz. But the world's first cruise missile couldn't break the British fighting spirit. On the contrary…

Southern England 1944

THE STAGE IS SET

England
London

The Allies have landed in Normandy and the fight is being taken to Germany. But Hitler will battle to the end. Nazi engineers have developed a new superweapon to spread terror in Britain in the hope of forcing the Allies to sue for peace. It's early on a June morning and the brand-new V-1 rocket is ready to launch against London.

On 13th June, Edwin Woods, a member of the Home Guard, was on duty in south-east England. At 04.00 he caught sight of a flying object through his binoculars. Woods was unable to identify what he saw, so just reported that a fighter aircraft on fire had crossed the English coast and was heading north.

Soon after, another observer spotted the flying object with fire coming from its tail. It was loud and sounded like an old Ford Model T. A guard at a nearby observation post, Ernest Woodland, guessed what it was: the Germans' flying bomb. The intelligence service had warned them about it. Woodland grabbed the phone and gave a coded message: "Mike 2, Diver, Diver, Diver – on four, north-west one-on-one."

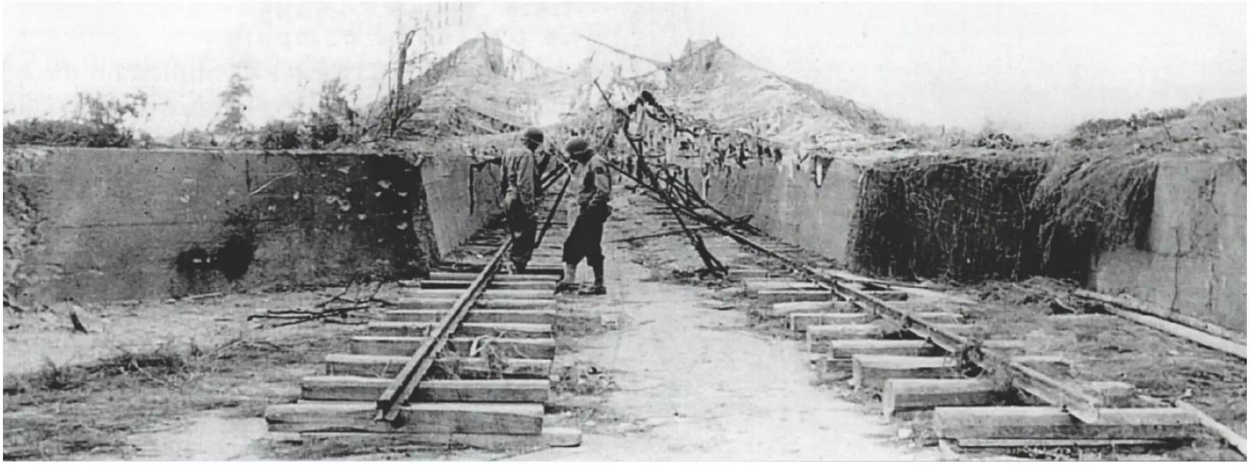
From Central Command in London, the message was passed on to the RAF's fighter squadron in Uxbridge, which immediately sent up an aircraft. Meanwhile, air raid sirens begin to howl in the capital. Reports of the first V-1 to cross the Channel continued to arrive for the next five minutes – until the flying bomb suddenly dived and landed harmlessly in a meadow outside London. Another V-1 exploded shortly afterwards in a potato field. But the third hit its target.

EXPLOSION FOLLOWED OMINOUS SILENCE

New mother 19-year-old Ellen Woodcraft was in her flat in Bethnal Green in London's East End. When she heard the sirens, she grabbed her eight-month-old son and took shelter in the basement. Soon after, she heard a loud, unusual noise. Not the familiar deep drone of German bombers, a sound that Londoners knew all too well. Something else – something no one had heard before.

Suddenly, the sound stopped and there was complete silence for several seconds. Then her surroundings were engulfed in a giant explosion, and the house collapsed around Ellen Woodcraft. The next day, Ellen and her son Tom

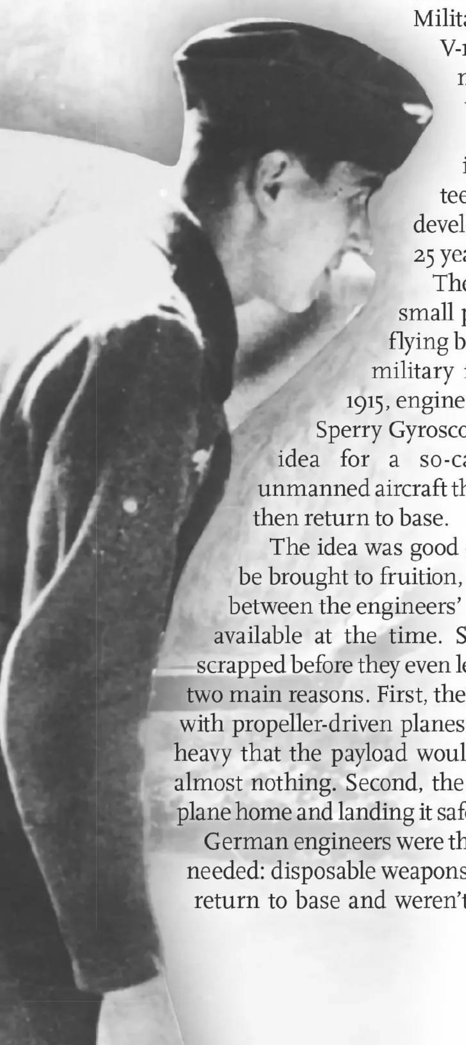
The V-1 bomb being prepared for launch in northern France. It could reach London in 48 minutes.



Long ramps were used to launch the V-1s. The missiles were fired by means of a gas-powered catapult, which reached a speed of 580 kilometres per hour. However, the launchers were difficult to hide and proved easy targets for Allied bombers.

appeared on the list of six victims of the first V-1. Another 30 people were injured, two buildings had been turned to rubble, and a railway bridge was destroyed.

For nearly four years – since the Battle of Britain – the RAF had controlled the airspace and protected the civilian population quite effectively from German bombers. Londoners had thought that the Blitz was long over. Now they were forced to accept that a new Blitz had begun.



BRAND-NEW TECHNOLOGY

Military experts consider the V-1 to be the first-ever cruise missile. The flying bomb was a technological breakthrough, despite all its shortcomings and teething problems, and its development took more than 25 years.

The idea of transforming a small plane into an unmanned flying bomb was almost as old as military flight itself. As early as 1915, engineers at the American firm Sperry Gyroscope Co came up with the idea for a so-called air torpedo, an unmanned aircraft that could drop its payload, then return to base.

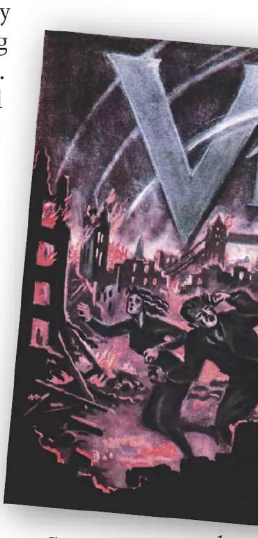
The idea was good – but it couldn't possibly be brought to fruition, as there was a huge gulf between the engineers' ideas and the technology available at the time. Sketch after sketch was scrapped before they even left the drawing board, for two main reasons. First, the engineers were working with propeller-driven planes, whose engines were so heavy that the payload would have to be reduced to almost nothing. Second, the problems of getting the plane home and landing it safely were insurmountable.

German engineers were the first to realise what was needed: disposable weapons that weren't designed to return to base and weren't powered by a propeller engine, but by a powerful, light, inexpensive jet engine. A talented German engineer, Paul Schmidt, designed a simple jet engine, the so-called pulsejet, and in 1935 presented the newly created Luftwaffe with a design for a flying bomb.

However, the Luftwaffe wasn't interested. Paul Schmidt's project was described as "technically dubious and uninteresting from the tactical viewpoint".

The harsh judgment was not only an expression of conventional wisdom, but also common sense. The weapon was so inaccurate that it could only be used for indiscriminate bombing of, for instance, a metropolitan area. Also, the Luftwaffe had developed major plans for a fleet of modern bombers that could better solve the problem. So there was little point investing vast sums of money on the development of a weapon that wasn't needed.

The Luftwaffe also rejected ideas from another engineer, Fritz Gosslau, who wanted to deploy an unmanned aircraft with a tonne of explosives against enemy bomber formations. The Luftwaffe didn't dismiss the two engineers entirely, however. In 1940, it paired up Schmidt and Gosslau, hoping that they would inspire one another to come up with something genuinely useful. They were helped by a third engineer, Robert Lusser from the Fieseler aircraft factory. Lusser would be the brains behind the prototype Fieseler Fi-103, later known as the V-1.



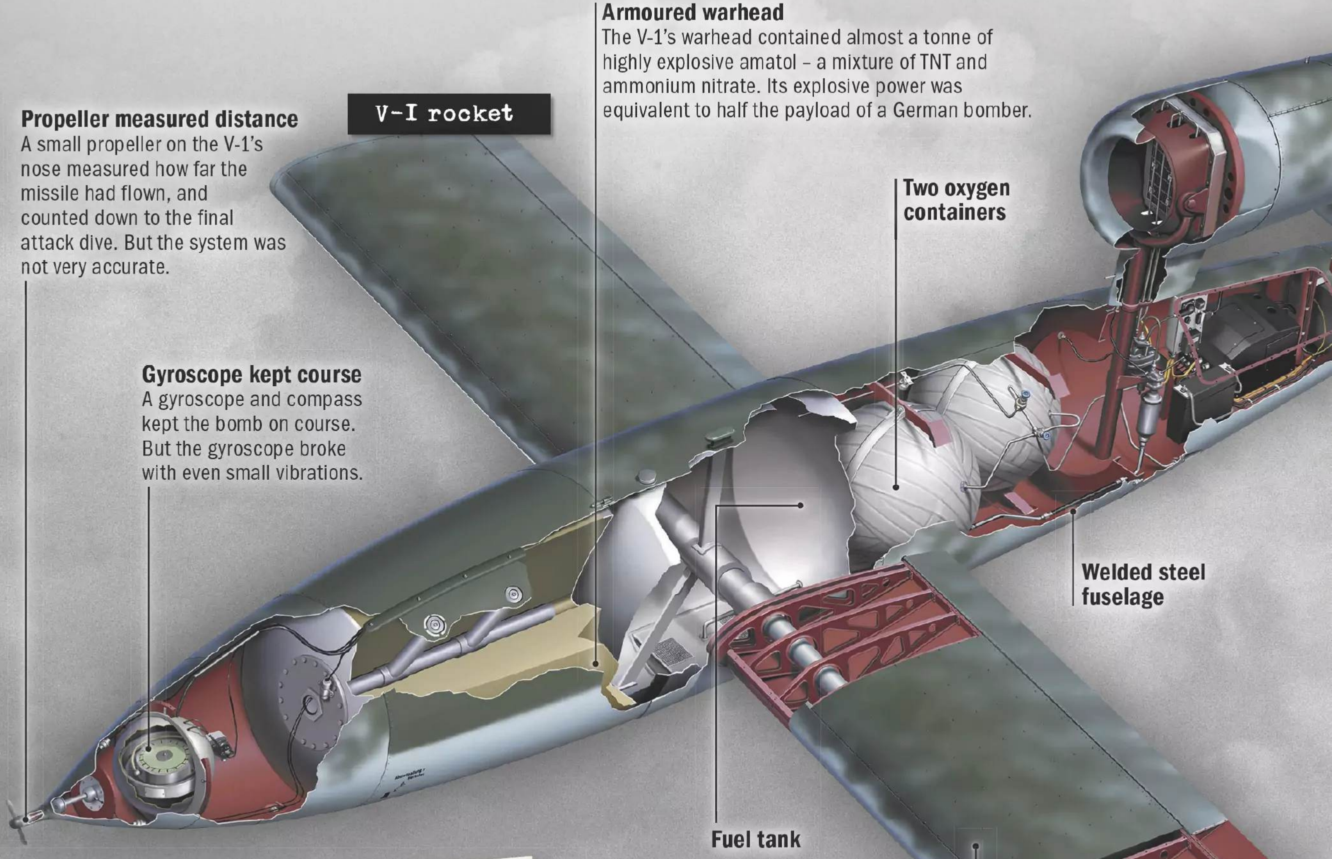
German propaganda posters were dropped at the front to intimidate Allied soldiers.

HITLER DEMANDED MASSIVE RETALIATION

Even before 1940 was over, however, the war took a sudden turn that thwarted the Luftwaffe's original plan. Against all odds, the German Air Force lost the Battle of Britain. Dogged British fighter defences shot down

Missile was a budget product

The V-1 was a technological breakthrough and the predecessor of the modern cruise missile, but the wonder weapon was also hastily produced on the cheap, and lacked both accuracy and durability.



Propeller measured distance
A small propeller on the V-1's nose measured how far the missile had flown, and counted down to the final attack dive. But the system was not very accurate.

Gyroscope kept course
A gyroscope and compass kept the bomb on course. But the gyroscope broke with even small vibrations.

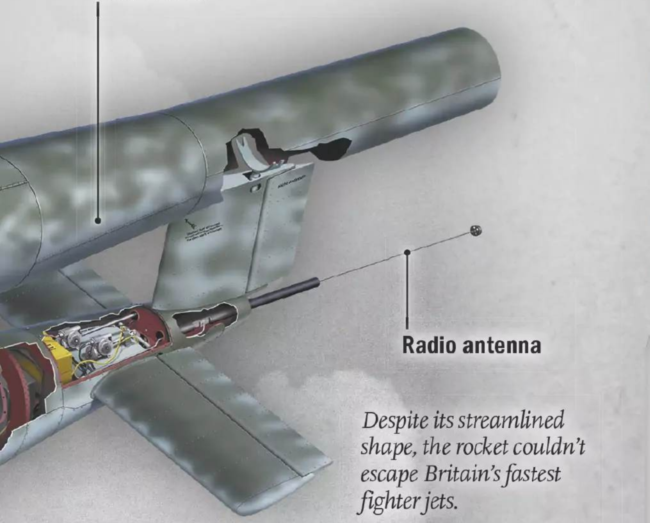
Armoured warhead
The V-1's warhead contained almost a tonne of highly explosive amatol – a mixture of TNT and ammonium nitrate. Its explosive power was equivalent to half the payload of a German bomber.

A German technician fine-tunes a bomb before launch. The jet engine can be seen at the top.

German bombers en masse and eventually drove the Luftwaffe from the sky. The Luftwaffe couldn't destroy London the same way as it had laid waste to Warsaw.

In 1941 and 1942, the British also launched a systematic bombing offensive against German cities, and Hitler demanded retaliation. Luftwaffe command suddenly needed the flying bomb, so the project was accelerated. The first V-1 was completed on 30th August 1942. After a series of tests on the ground, engineers were ready for a test flight, which took place at the village of Peenemünde on the German Baltic coast. The jet engine was fired up and a gas-powered catapult launched the V-1. The bomb flew for around a minute and reached 500 kilometres per hour before crashing into the sea.

The result was promising, but then the problems began. By the end of July 1943, the Germans had completed 68 test flights, but only 28 had been successful. One of the problems



Engine beat like a heart
The V-1 was powered by a so-called pulsejet engine, which pumped fuel into the combustion chamber 47 times a second, just like the heart pumps blood.

Radio antenna

Despite its streamlined shape, the rocket couldn't escape Britain's fastest fighter jets.

Vergeltungswaffe 1 (V-1)

Length	7.73 metres
Wingspan	5.33 metres
Diameter (fuselage)	82.5 centimetres
Weight	2,200 kilograms
Explosives	850 kilograms of amatol
Top speed	670 km/h
Range	210 kilometres
Accuracy	13 kilometres

BOMB WAS CHEAP

Pros: The V-1 rocket cost only 5,600 Reichsmark to make, and the manufacturing process took just 350 man-hours.

Cons: It often failed before or shortly after launch, and was easy to knock off course.

was that the engine and fuselage didn't go together very well. The V-1 had to transport a one-tonne bomb, so it was equipped with a very powerful engine and a small, light body. But the engine caused the missile to vibrate so much that it was often shaken to pieces just a few seconds after launch.

At the same time, the disposable weapon had to be cheap and quick to produce, so everything was designed as simply as possible. But this came with its own cost: on several test flights, the V-1's wings fell off. This forced the engineers to scrap 1,400 V-1 bodies, which the factory had only spot-welded to save time.

BATTLE OF LONDON
JUNE 1944 AUGUST

A medal to commemorate victims of the London attacks.

The developers were also up against the clock, because high command wanted the first 5,000 V-1s ready by 15th December 1943. Even though the problems were eventually resolved one by one, the deadline was unrealistic.

Production at the Fieseler and Volkswagen factories began in August. But two months later, Allied bombers attacked the Fieseler plant and levelled the V-1 production line. Later they did the same to the VW factory. Only when V-1 production was moved to an underground factory did production step up a gear. The work was carried out by concentration camp prisoners in miserable conditions, and the V-1 cost thousands of lives even before the first missile was launched.

BRITAIN FOLLOWED THE PROJECT

British intelligence knew about the V-1 project early on. At the end of August 1943, a test launch on the Baltic Sea ended with an unarmed V-1 crashing onto Bornholm island. Danish resistance fighters were quickly on the scene and managed to photograph the wreck before the Germans cordoned off the area . The pictures were sent to London.

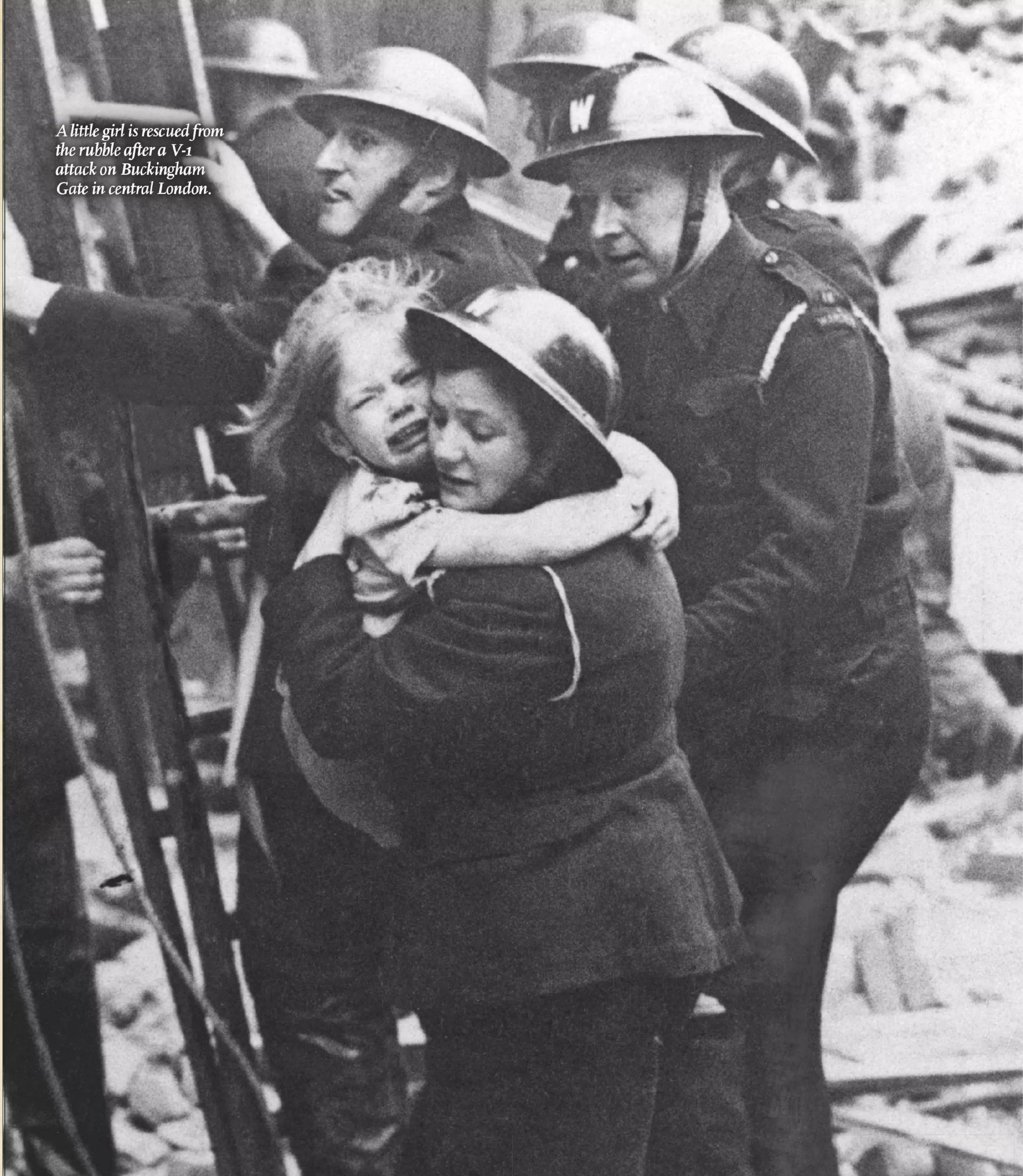
Meanwhile, French resistance fighters found out where in Normandy the Germans were building launch ramps, and passed the information on to the British. Allied reconnaissance aircraft located the bases as quickly as the Germans could build them. By the end of January 1944, the Allies knew of 96 V-1 bases under construction and launched a massive bombing campaign. By the end of April, 18 had been destroyed and 48 severely damaged.

General Erich Heinemann was the commander of the special Luftwaffe unit that was to fire the V-1 weapons. He quickly realised that it would be impossible to use the original launch sites, but decided to keep repairing them to keep the Allied bombers busy. He also ordered the secret construction of a series of new, temporary launch bases that were much smaller and better camouflaged than the old ones.

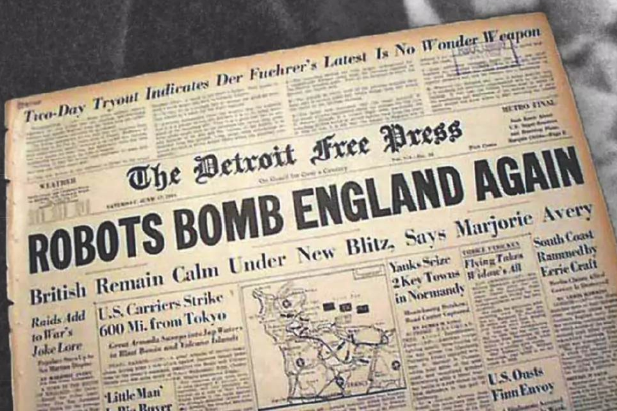
An increasingly frustrated Hitler made no secret of his impatience. Heinemann stood firm for a long time, but when the Allies landed in Normandy on 6th June 1944, the project's launch could be delayed no longer.

Heinemann still faced a number hurdles, though. Many of the bases were only half-finished. His men hadn't been fully trained. And the so-called wonder weapon was far from ready for use. High command, however, didn't want to hear any more excuses; it just wanted to see the bombs rain down over London. The general realised he'd just have to fire and hope for the best.

Heinemann ordered the first salvo to be fired on 12th June at 23:00. Sixty-three out of a total of 72 launchers were ready, but the result of the first launch was disappointing. Only nine V-1s left the launch ramps and all of them crashed before reaching England. A new salvo was ordered the



A little girl is rescued from the rubble after a V-1 attack on Buckingham Gate in central London.



Two-Day Tryout Indicates Der Fuehrer's Latest Is No Wonder Weapon

METRO FINAL

The Detroit Free Press

WEATHER

ROBOTS BOMB ENGLAND AGAIN

British Remain Calm Under New Blitz, Says Marjorie Avery

Raids Add to War's Joke Lore

U.S. Carriers Strike 600 Mi. from Tokyo

Yanks Seize 2 Key Towns in Normandy

Flying Takes Widow's All

South Coast Rammed by Eerie Craft

U.S. Ousts Finn Envoy

'Little Man'

News of the fresh German bombing campaign caused outrage in large parts of the world.

same night, at 03.30 on 13th June. This time, ten V-1s launched. However, four crashed, while two more disappeared into the Channel. The last four reached England, but three did no harm. Only one V-1 hit London – the one that, at 04.18, crashed into Bethnal Green, killing Ellen Woodcraft, her infant son, and four others.

Nineteen V-1s – the missiles heralded as the new wonder weapons – had killed a total of six Britons between them. Seen through German eyes, that first attack was a disaster. Heinemann wasn't looking forward to hearing the Führer's reaction.

The British weren't impressed, either. At a cabinet meeting the same day, Winston Churchill's scientific adviser, Lord Frederick Cherwell, expressed his opinion in words borrowed from the Greek fable writer, Aesop: "The mountain hath groaned and given forth a mouse!"

LONDON HIT 73 TIMES IN ONE DAY

The following day, 14th June, Heinemann's people worked feverishly to locate and correct the faults that had prevented most of the V-1s from functioning as intended. A day later, they made another attempt.

In quick succession, 244 V-1s were fired, of which 45 crashed shortly after take-off and several while crossing the Channel. Of the 144 that reached the English coast, 45 were shot down by anti-aircraft guns, and seven by fighter jets, while others veered off course. But 73 V-1s hit London, each detonating its one-tonne payload, spreading death, destruction, and terror. The situation suddenly looked very different.

The British could only console themselves with the fact that they were so well-prepared – 480 barrage balloons and 1,512 anti-aircraft guns were positioned along the stretch of English coast that the V-1s had to cross on their way to the capital.

There were also the fighter pilots. The V-1 had a cruising speed of around 670 km/h. This made it possible for the fastest British fighter jets, such as the Spitfire and Mosquito, to catch up with the missile and render it harmless it before it reached London.

By early July, the Germans had fired around 4,000 missiles. Only around 3,000 reached the British coast, of which 924 were taken out by fighter jets, and 261 by anti-aircraft guns. Another 55 crashed after hitting barrage balloons or their steel cables. However, that still meant that over 1,700 V-1s hit London in a single a month.

Although the British refused to be cowed, the V-1 created exactly the kind of terror that Hitler had hoped for. What was particularly unnerving about the weapon was that it was indiscriminate – anyone could be the next victim. Its sound contributed to the horror. The missile made a hellish roar, but the engine cut out once the bomb began diving towards its target, and a few seconds of dead silence followed. The V-1

WEAPON'S DEVELOPMENT WAS REVEALED BY SPIES

1942

DECEMBER

The **first test flight** of a V-1 bomb takes place in Germany after several years of development.

1943

JUNE

British intelligence **uncovers rocket launches** at a secret German base at Peenemünde.

AUGUST

The base at Peenemünde is **bombed.** Several installations are destroyed, so the project is delayed.

1944

13TH JUNE

The first V-1 bombs are **fired at London.**

30TH JUNE

A **V-1 detonates** outside the Air Ministry building in Aldwych, central London, killing 48 people.

4TH JULY

Allied bombing raids on launch bases in France **reduce the number of attacks** on London.

AUGUST

Improved air defences and new techniques to knock V-1s off course further limit the number of attacks.

SEPTEMBER

The last German bases from which V-1 bombs can reach England are **captured.** The attacks on London stop.

OCTOBER

Attacks on **Belgian cities,** particularly Antwerp, begin.

1945

29TH MARCH

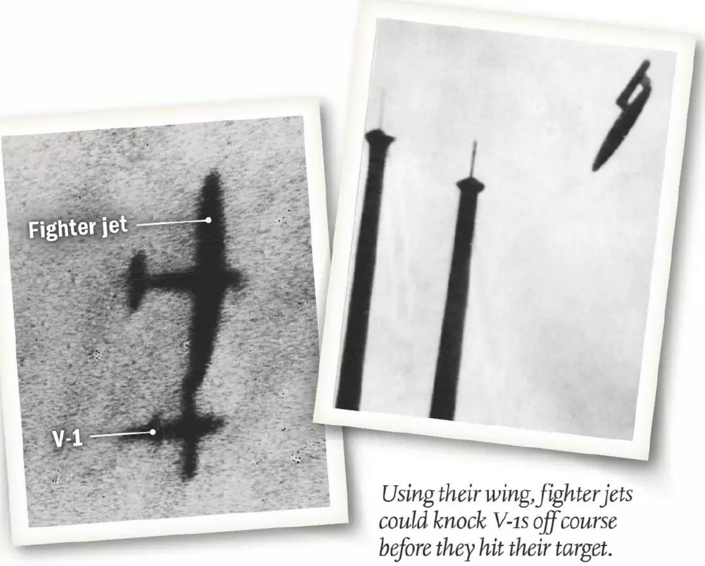
The last launch base is captured by Allied troops, and the V-1 **attacks stop completely.**

Allied experts studied unexploded V-1s that had crashed to the ground.

was not just a weapon of terror in the technical sense – it was also a psychological one.

As in the first Blitz, tens of thousands of children were evacuated to the countryside. Those who had to stay behind in London armed themselves with black humour. It became something of a game to come up with the funniest nickname for the hated V-1s, whose engine noise was reminiscent of a sustained bout of broken wind. "Farting furies" became a popular term.

The V-1 offensive peaked on 3rd August 1944. A total of 316 V-1s were fired that day, and 220 hit London. From then on it became less effective, not least because of increasingly improved air defences. British fighter pilots developed a technique in which they flew so close to a V-1 that the aircraft's wing was just below the bomb. Then the pilot rolled so that the fighter's wing clipped the V-1 and flipped it over, after which it crashed to the ground. At the same time, production of the flying bombs couldn't keep up, because the Allies' air superiority made it difficult to get the weapons to the few usable launchers that were still in German hands.



Using their wing, fighter jets could knock V-1s off course before they hit their target.

Belgians became new victims of V-1

Tough German resistance kept the Allied invasion force stuck in Normandy longer than expected, but eventually the Allied armies managed to break out and capture terrain at a rapid rate. The V-1 units had to retreat with the rest of the German forces. The last V-1 was fired from France on 1st September.

However, the V-1 units built new launch bases, first in Belgium and Holland, and finally on the German side of the Rhine. But the flying bombs could no longer reach London. Instead, more than 10,000 V-1s were fired at the newly liberated Belgian cities of Liège, Brussels and – in particular – Antwerp. Nearly 15,000 Belgians were killed or wounded.

In February 1945, the V-1 units were supplied with a new model with a longer range, which could again hit London. In a final gasp, 275 bombs were fired, 13 of which reached the capital. The last fell on the city on 29th March. That was the end of the V-1.

The V-1 flying bomb killed around 5,500 Britons. Although it spread fear, it failed to break the British people, as Hitler had hoped; on the contrary, it helped to strengthen the Allied fighting spirit. Military historians also believe that the Germans committed a huge error by spending so much of their resources on the V-1. As V-1 expert Steven J Zaloga wrote: "While the V-weapons may have satisfied Hitler's thirst for revenge, from a military perspective, they were utter folly."

Hitler wanted kamikaze aircraft

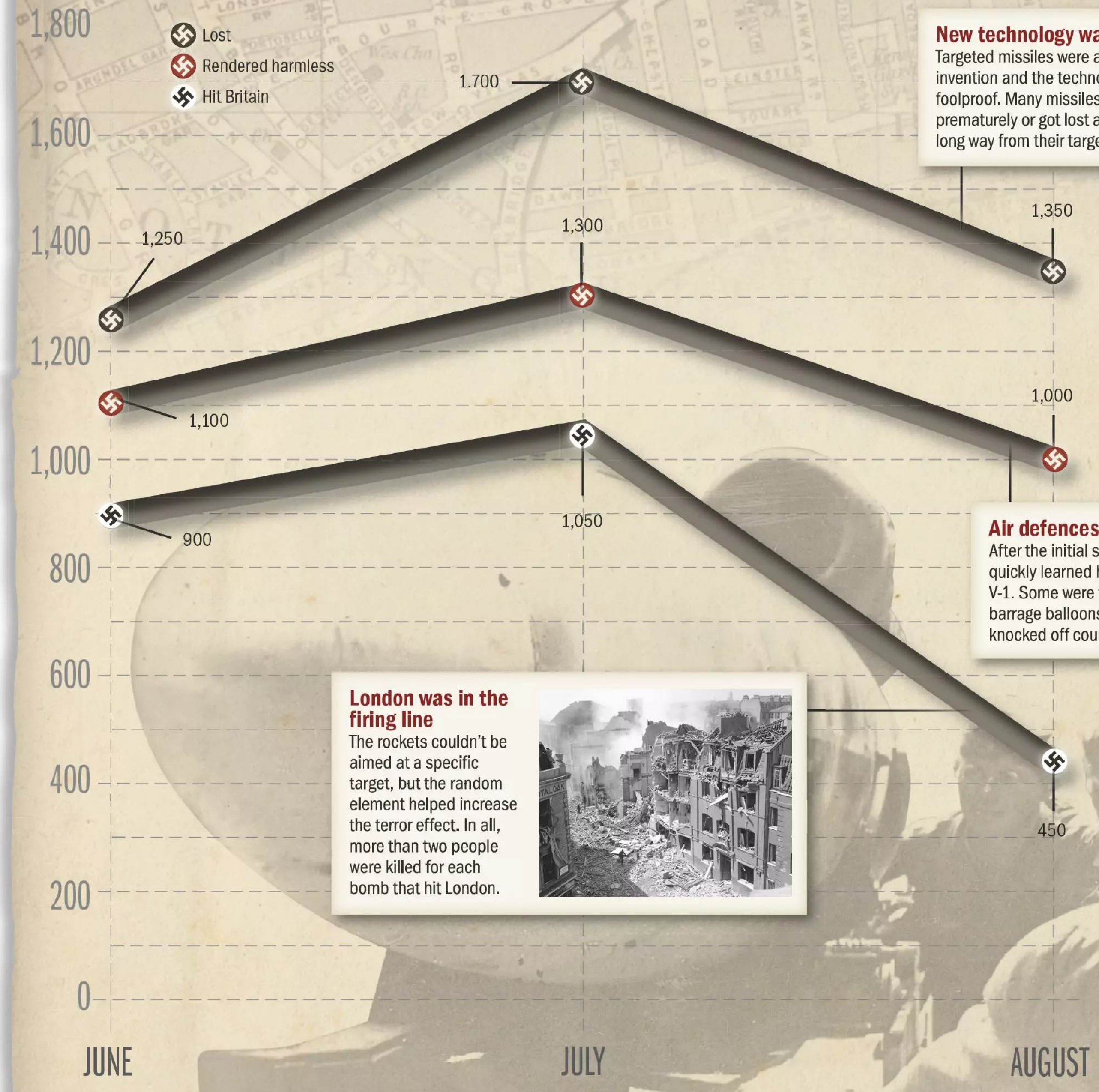
Seventy pilots volunteered to die for Germany in a converted version of the V-1. The suicide plane was to be deployed against particularly important targets, but it created huge divisions within the Luftwaffe.

In 1944, the development of a manned version of the V-1 began. The pilot, who sat in a cockpit in front of the jet engine, had to steer the bomb towards its target. He could then – in theory – choose to parachute out or remain in the bomb and die for the fatherland. The plan shocked many Luftwaffe commanders, but no one dared to oppose Hitler. The plane was built and 70 pilots volunteered. Test flights, however, showed that, in practice, it was impossible to get out with a parachute. The plane was very unreliable, too. The project leader lost faith in the scheme and contacted Minister of Armaments, Albert Speer. He convinced Hitler that suicide attacks were contrary to German war tradition, and the Führer agreed to abandon the project.

The suicide plane was never deployed. Here, a converted bomb is examined by the British.

Three quarters of bombs failed

The V-1 bomb spread terror throughout London, but luckily the rocket wasn't very stable and proved quite easy to shoot down.

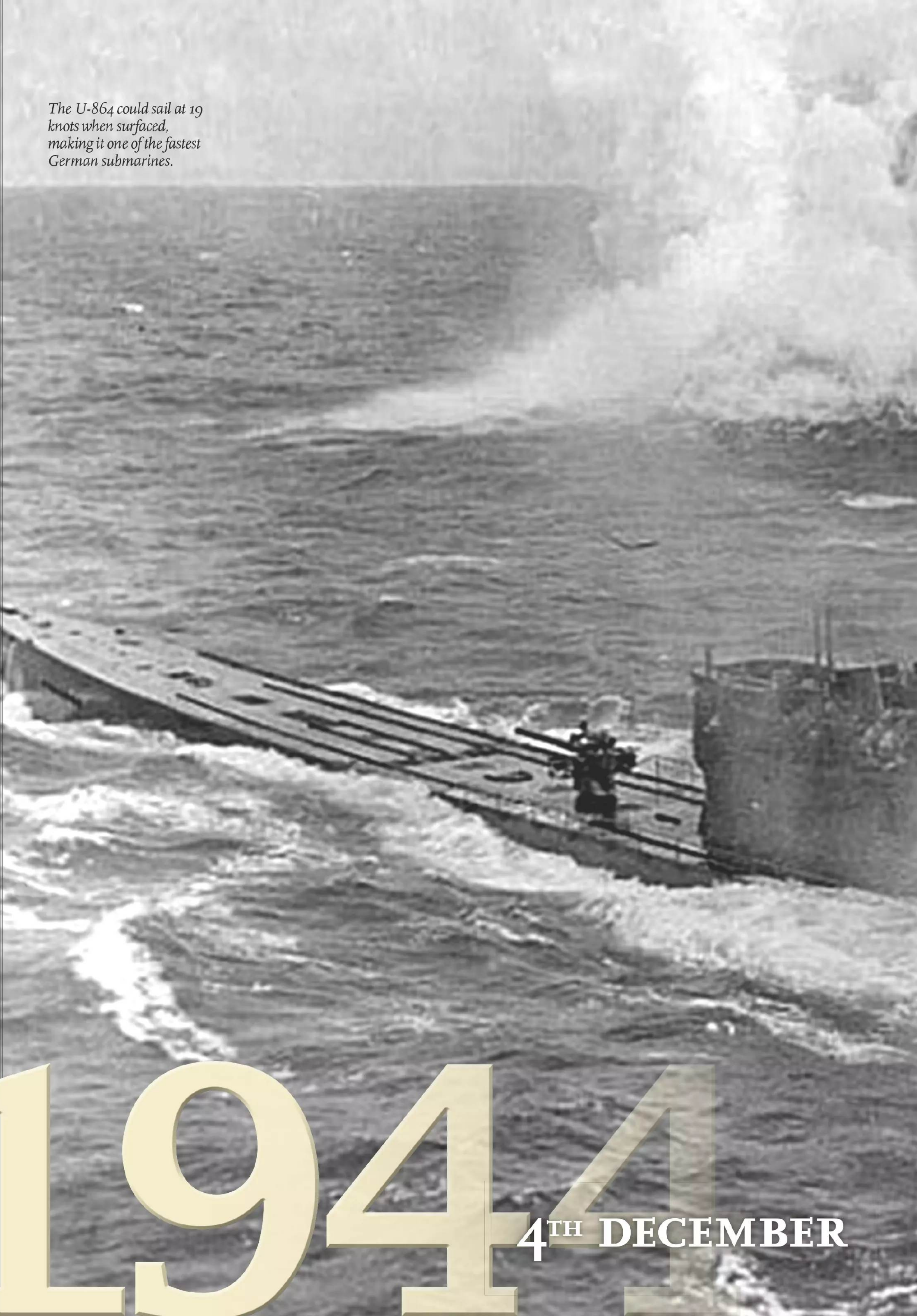


New technology was expensive
Targeted missiles were a brand-new invention and the technology wasn't foolproof. Many missiles exploded prematurely or got lost and crashed a long way from their target.

Air defences were effective
After the initial shock, the British quickly learned how to combat the V-1. Some were thwarted by barrage balloons, while others were knocked off course by fighter jets.

London was in the firing line
The rockets couldn't be aimed at a specific target, but the random element helped increase the terror effect. In all, more than two people were killed for each bomb that hit London.

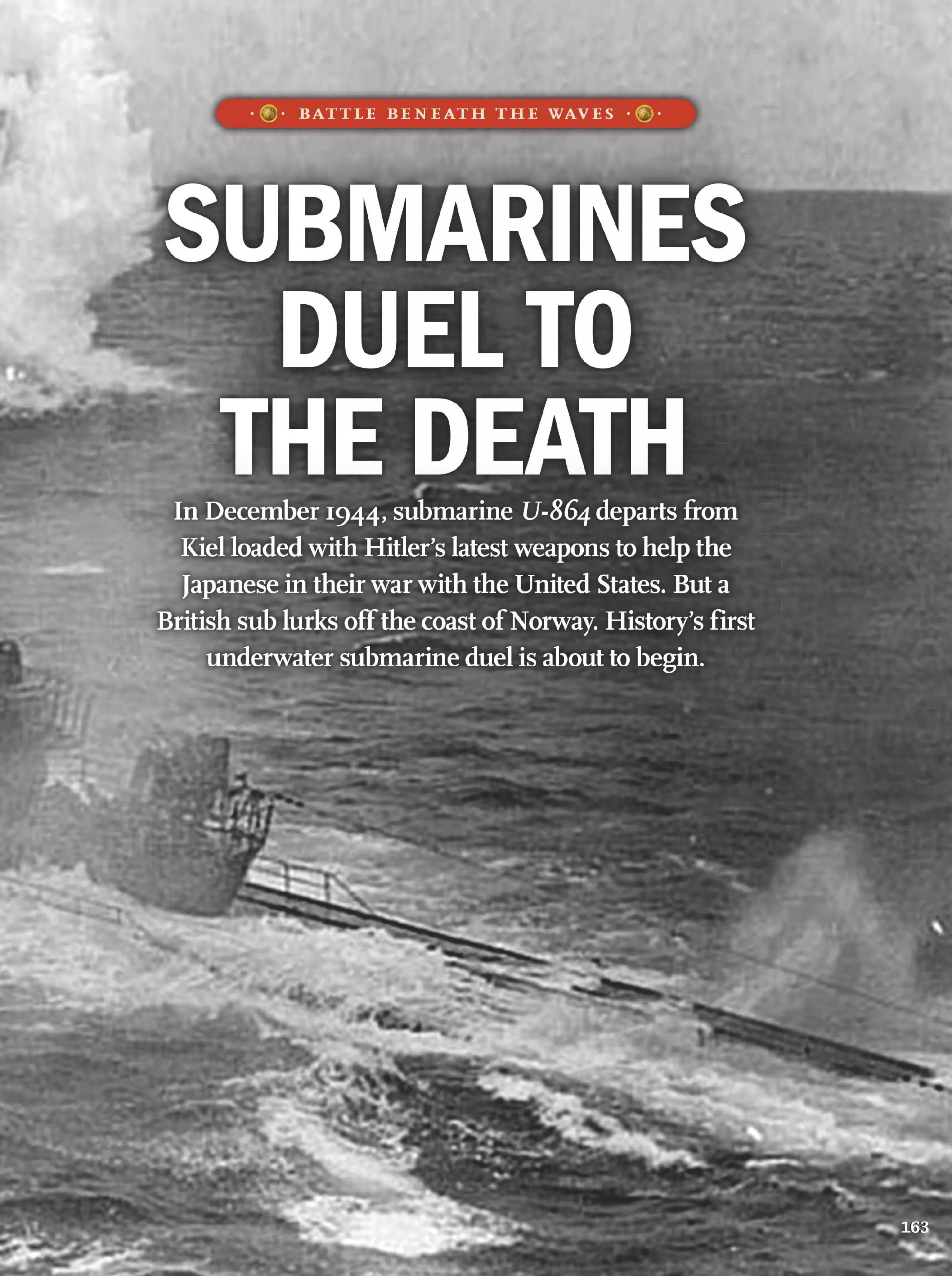
10,100	V-1 bombs launched by Germany against Britain.
2,400	reached their goal, primarily London.
5,500	Britons were killed in the attacks.
18,000	were wounded.



The U-864 could sail at 19 knots when surfaced, making it one of the fastest German submarines.

1944

4TH DECEMBER



BATTLE BENEATH THE WAVES

SUBMARINES DUEL TO THE DEATH

In December 1944, submarine *U-864* departs from Kiel loaded with Hitler's latest weapons to help the Japanese in their war with the United States. But a British sub lurks off the coast of Norway. History's first underwater submarine duel is about to begin.

Norwegian Sea, 1944-45

THE STAGE IS SET

By the end of 1944, the Allies have fought their way to the borders of the Third Reich. Things are no better for the Germans' allies in Japan, who are suffering major defeats in the Pacific. Hitler decides to send a submarine to Asia. It's loaded with the latest weapons technology to help reverse the fortunes of the Japanese troops.

Norway
Bergen

On 4th December, 1944, a column of trucks arrived in the port area of the northern German city of Kiel. Soldiers were secretly loading hundreds of wooden boxes aboard the submarine *U-864*. The boxes contained detailed blueprints and prototype parts for Nazi Germany's latest wonder weapons. The cargo included plans of the world's first jet fighter, the Messerschmitt Me 262 as well as a Siemens radar system and acoustic torpedo. In addition, troops loaded 61 tons of mercury for use as ignition kits in Japanese bomb production. The mission had been code named Operation Caesar and submarine captain Ralf-Reimar Wolfram's orders were simple: break through enemy lines to safely deliver the payload into Japanese hands.

NAME **RALF-REIMAR WOLFRAM**

TITLE SUBMARINE CAPTAIN

1912-1945

Commander achieved one victory

Despite his age – 32 – Ralf-Reimar Wolfram was an inexperienced commander when he boarded *U-864* at Kiel in 1944.

The trip to Asia was only the German's fourth voyage as U-boat captain, and he had just one victory to his name. On his third voyage with *U-108*, Wolfram sunk US boat the *SS Robert Gray* in April 1943 when it was shipping supplies to Britain.

- **Took command of *U-864* in 1943.**
- **Patrolled a total of 118 days.**

NAME **JAMES LAUNDERS**

TITLE SUBMARINE COMMANDER

1919-1988

Briton gained experience young

James Launders' sinking of *U-864* crowned an outstanding career as a submarine officer. He'd already received the Distinguished Service Cross in December 1942 for his efforts during the Battle of the Atlantic. In spring 1943, he was promoted to Lieutenant and one month later was given command of *HMS Venturer*. In addition to several merchant ships, Launders sunk two German U-boats.

- **Remained in the Royal Navy.**
- **Retired in 1974 as Commander.**

The Allies had full control of the sea, however, and since 1943 virtually no German ships had reached Japan. But Hitler wasn't giving up that easily. He was convinced that Japan could regain air superiority over the Pacific, forcing the US to transfer troops from Europe to the Far East and provide Germany's exhausted armies with much-needed respite. But the plan required that Japan receive technological help from Germany.

INEXPERIENCED CAPTAIN WAS SAILING TO ASIA

The following morning, *U-864* departed Kiel. On board was a total of 73 men who, besides the crew, included both German and Japanese engineers who would assist with the manufacture of the weapons in Japan. Captain Wolfram set a course north – in front of him lay a perilous voyage of 24,000 kilometres before he could deliver his payload to the Japanese Penang area in Malaysia.

Wolfram was 32 years old, making him older than most U-boat captains, but he had little experience either in combat or as a commander. All experienced German submarine commanders had long been killed in battle, and the previously feared "grey wolves" were now more prey than predator. Wolfram knew full well that British ships and aircraft controlled the North Sea, but he had no other option than to hope his luck would hold attempting to sneak through enemy lines unseen.

The captain was, however, completely unaware that the British already knew everything about his mission. Since the beginning of the war, the Germans had used the Enigma encoding machine to encrypt radio communications, but the British had long been able to decode the Enigma messages and knew that Wolfram was on his way.

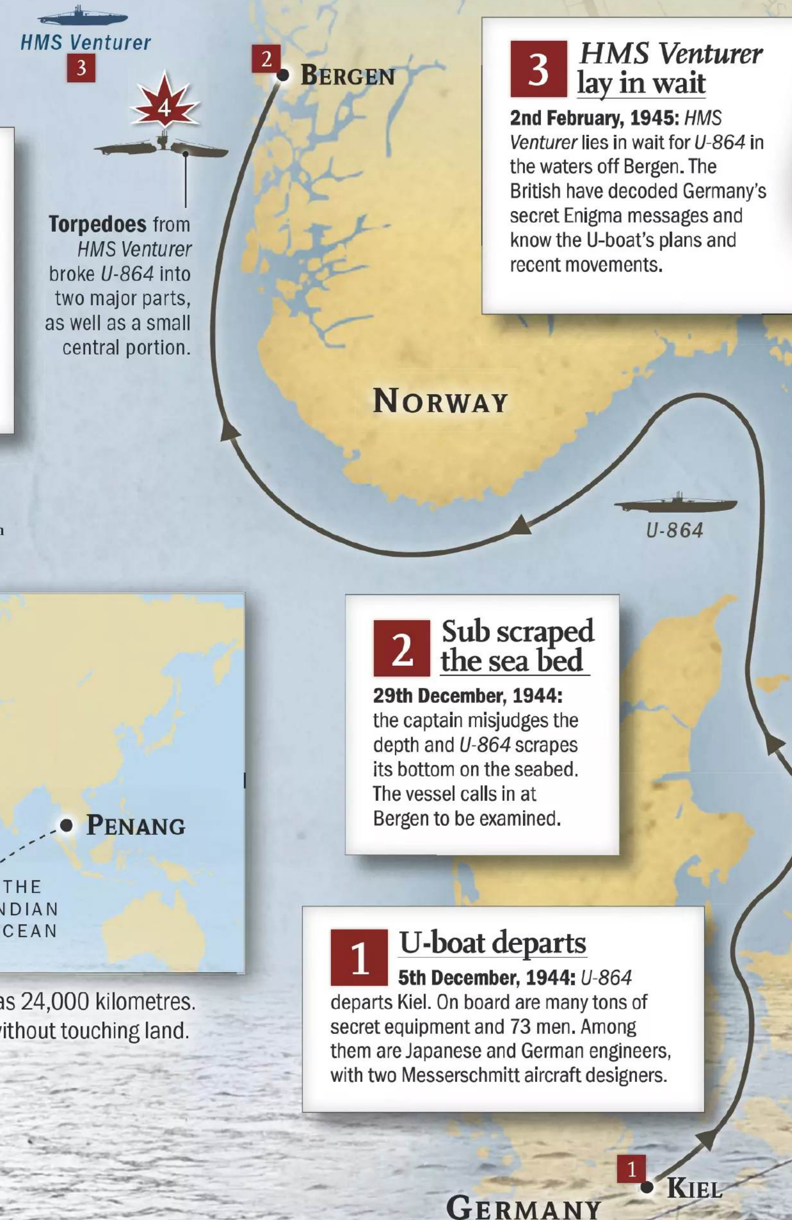
U-864 WAS FORCED INTO PORT

With British aircraft liable to pop up at any moment, *U-864* had to sail completely submerged during the day. After several days of sailing, the submarine had reach Norway's southern coast. But while the country was still occupied by Germany, Wolfram couldn't relax even though the captain had been lucky and not seen anything of the enemy up to this point.

On 29th December, things suddenly went wrong. Wolfram misjudged the sea depth, and scraped the sub's keel on the seabed. The submarine would be forced to dock in Bergen to investigate for possible damage. Wolfram messaged German High Command over the radio, and a few

Enigma revealed route

When *U-864* sailed from Kiel in December 1944, a secret voyage of 24,000 kilometres awaited. But the British had decoded the Germans' Enigma messages and knew everything about the mission. *HMS Venturer* lay in ambush underwater off Bergen.



4 U-boat was torpedoed

9th February, 1945: *Venturer's* torpedoes hit *U-864* off the island of Fedje. The U-boat breaks in two and lies 150 metres beneath the waves. None of the sub's 73-man complement survive.

Torpedoes from *HMS Venturer* broke *U-864* into two major parts, as well as a small central portion.

3 *HMS Venturer* lay in wait

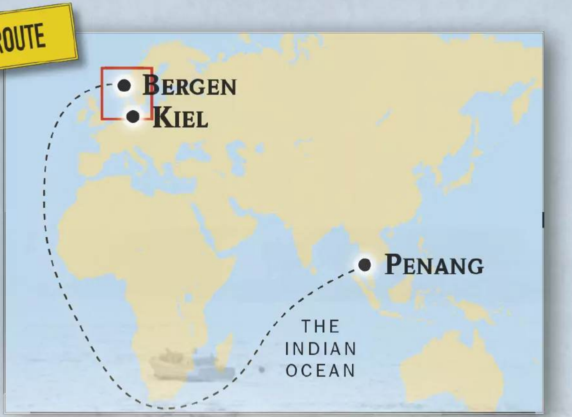
2nd February, 1945: *HMS Venturer* lies in wait for *U-864* in the waters off Bergen. The British have decoded Germany's secret Enigma messages and know the U-boat's plans and recent movements.

The Enigma machine encrypted German messages.

2 Sub scraped the sea bed

29th December, 1944: the captain misjudges the depth and *U-864* scrapes its bottom on the seabed. The vessel calls in at Bergen to be examined.

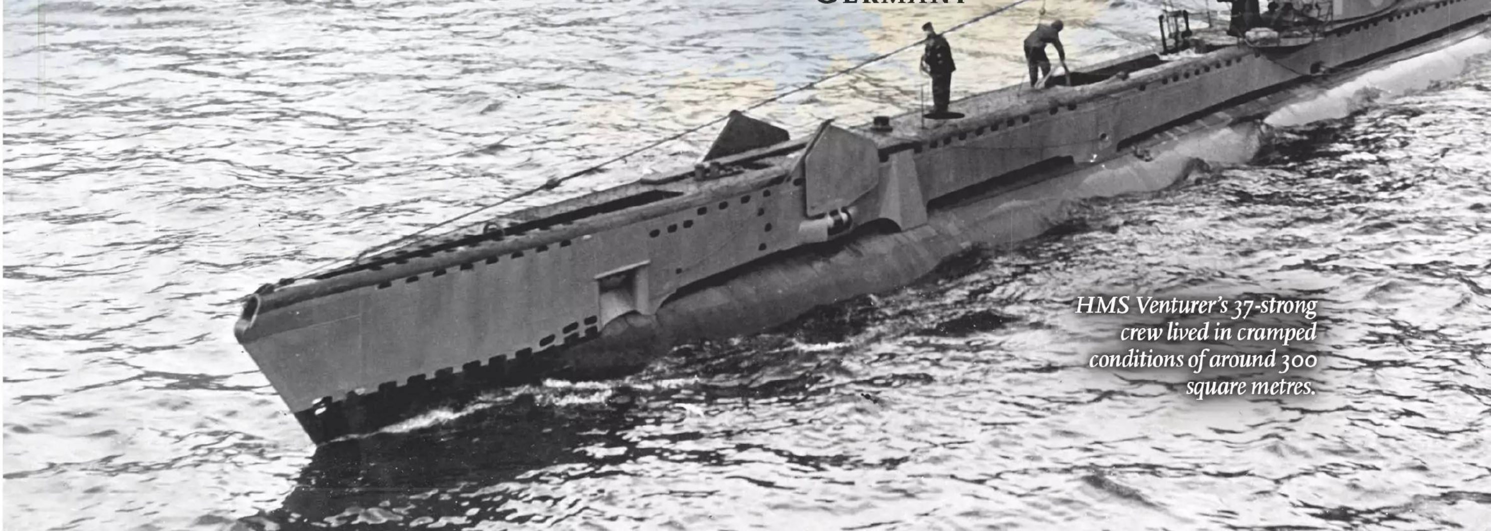
ROUTE



The trip from Kiel to Penang was 24,000 kilometres. *U-864* could complete the trip without touching land.

1 U-boat departs

5th December, 1944: *U-864* departs Kiel. On board are many tons of secret equipment and 73 men. Among them are Japanese and German engineers, with two Messerschmitt aircraft designers.



HMS Venturer's 37-strong crew lived in cramped conditions of around 300 square metres.

days later *U-864* entered U-boat pen "Bruno" at Bergen where technicians immediately examined the vessel. In the meantime, the British had intercepted the message and sent around 30 Lancaster bombers to target the pens where *U-864* was docked. The pen's ceiling was reinforced concrete six metres thick, but the British were carrying special "bunker buster" bombs, each weighing almost six tons. The explosions damaged the sub, forcing it to undergo a major repair. But the British weren't yet finished attacking the vessel.

YOUNG BRITON MUST SINK U-BOAT

Lieutenant James Launders was in command of British submarine *HMS Venturer*. Although only 25 years old, Launders had been recognised as one of Britain's best submarine commanders. The 545-ton Venturer had – under his command – sunk 13 enemy vessels in the North Sea and North Atlantic. Launders was also one of a select band who'd torpedoed an enemy submarine as it lay on the surface, but soon he'd surpass even this impressive feat.

The Admiralty in London ordered the captain to sail the *Venturer* to Norway – specifically the island Fedje close to Bergen. Here Launders was told to wait for the *U-864* and make sure the German submarine couldn't reach her target.

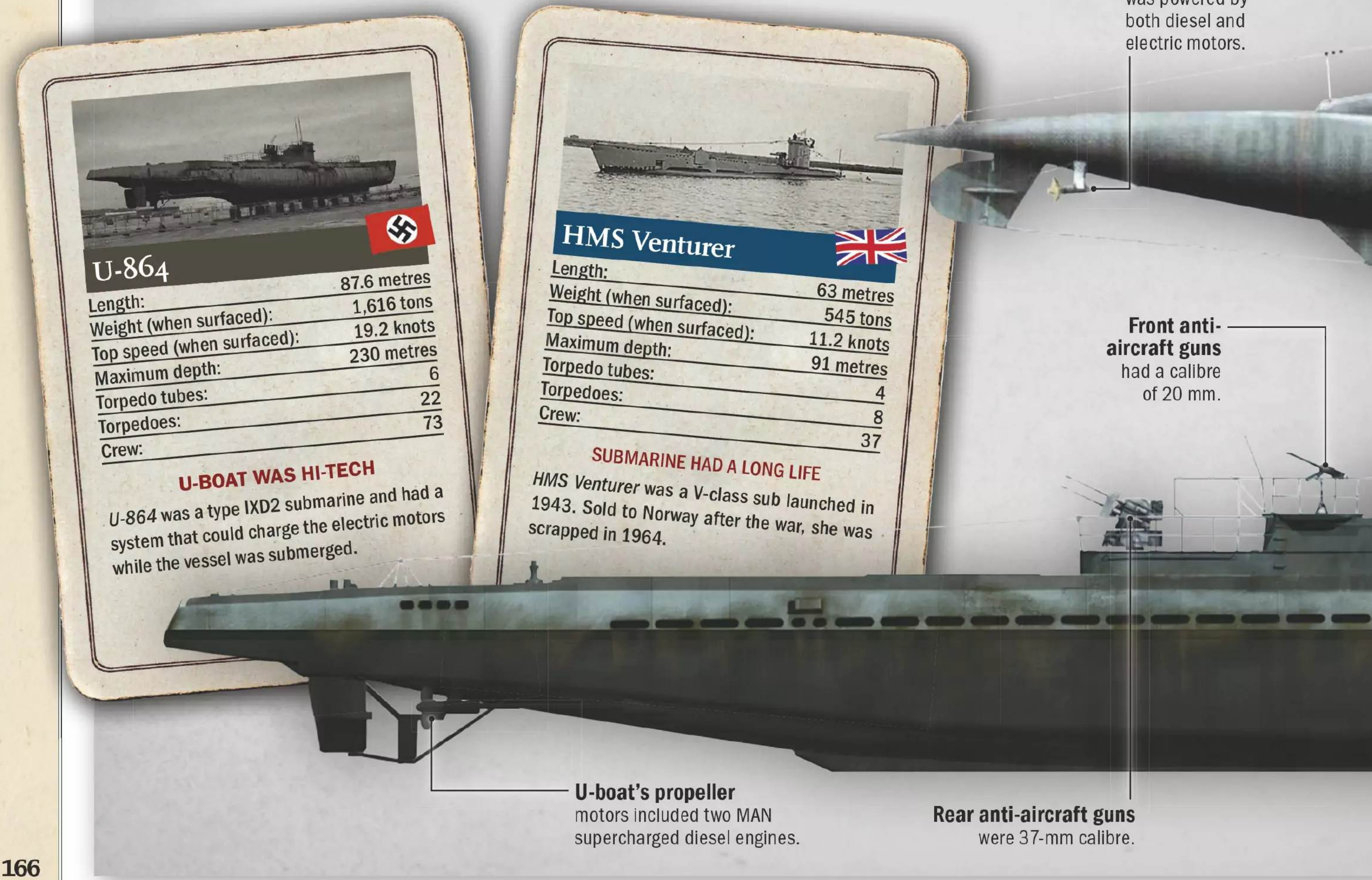
Venturer spent three days waiting patiently off the Norwegian coast for contact with *U-864*. On 5th February, Launders was ordered to position the submarine next to the lighthouse at Hellisøy on Fedje's southern coast. By now *U-864* had been docked for almost a month and was finally

SUBMARINES

U-boat was too big and heavy

Although *U-864* was faster, dived deeper and was armed with more torpedo tubes, the vessel still lost to its British opponent, *HMS Venturer*.

Germany's U-boats had clear advantages over their British counterparts. *U-864* could sail twice as fast as *HMS Venturer* and was armed with three times as many torpedoes as normal submarines. However, *U-864* was a colossus weighing 1,616 tons and 87.6 metres long. She had feet of clay when it came to manoeuvring compared to the nippy 545-ton and 63-metre-long *Venturer*.



U-864

Length:	87.6 metres
Weight (when surfaced):	1,616 tons
Top speed (when surfaced):	19.2 knots
Maximum depth:	230 metres
Torpedo tubes:	6
Torpedoes:	22
Crew:	73

U-BOAT WAS HI-TECH

U-864 was a type IXD2 submarine and had a system that could charge the electric motors while the vessel was submerged.

HMS Venturer

Length:	63 metres
Weight (when surfaced):	545 tons
Top speed (when surfaced):	11.2 knots
Maximum depth:	91 metres
Torpedo tubes:	4
Torpedoes:	8
Crew:	37

SUBMARINE HAD A LONG LIFE

HMS Venturer was a V-class sub launched in 1943. Sold to Norway after the war, she was scrapped in 1964.

Sub's propeller was powered by both diesel and electric motors.

Front anti-aircraft guns had a calibre of 20 mm.

U-boat's propeller motors included two MAN supercharged diesel engines.

Rear anti-aircraft guns were 37-mm calibre.

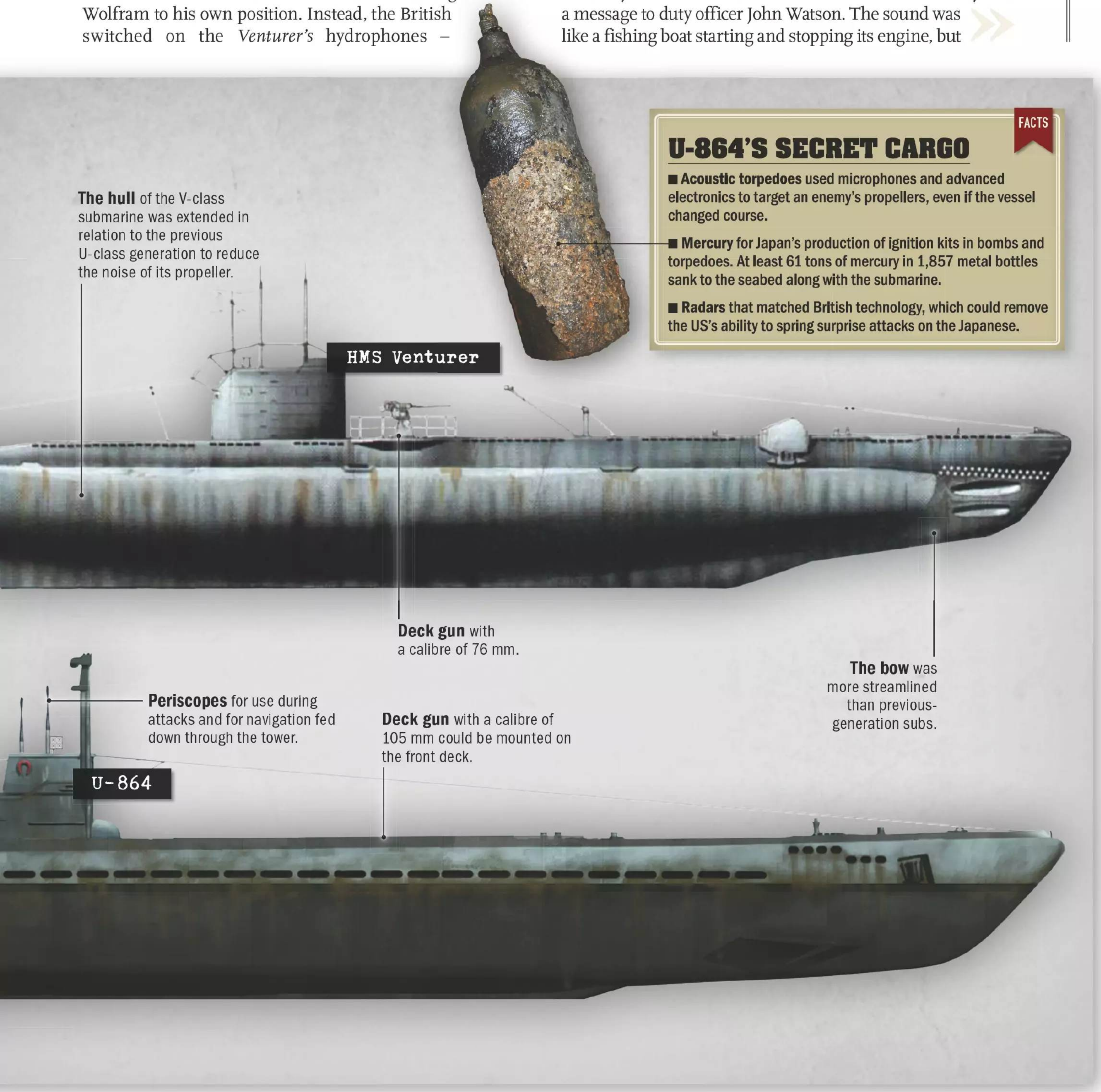
ready to continue her journey. The following day, *U-864* departed Bergen and sailed through the deep water of the fjord and out into the open sea right past *Venturer* without being discovered. Launders quickly realised that the U-boat must have slipped past. But now he faced hunting for her over a vast area spanning several thousand square kilometres.

The British submarine commander considered using sonar to search for the enemy. It transmitted a sound wave from the British sub through the water and – when it hit an object (such as an enemy sub), an echo would be sent back. Sensors would then detect how quickly the sound came back to determine position and distance. But the Germans would be able to hear the British sonar and Launders would risk alerting Wolfram to his own position. Instead, the British switched on the *Venturer's* hydrophones – underwater mikes – to listen for noises from the *U-864's* propeller and engine. Hydrophones were far less precise than sonar, but Launders refused to risk revealing his own position.

U-864 SUFFERED SECOND MISHAP

Meanwhile, Wolfram and *U-864* were finally on their way to the Atlantic when they suffered another mishap. At 05.20 on 8th February, one of the engines developed a fault. This repair could not be made on the open sea, so Wolfram was forced to message command again, which answered that an escort ship would meet the sub off Hellisøy. Wolfram began the return trip to Bergen.

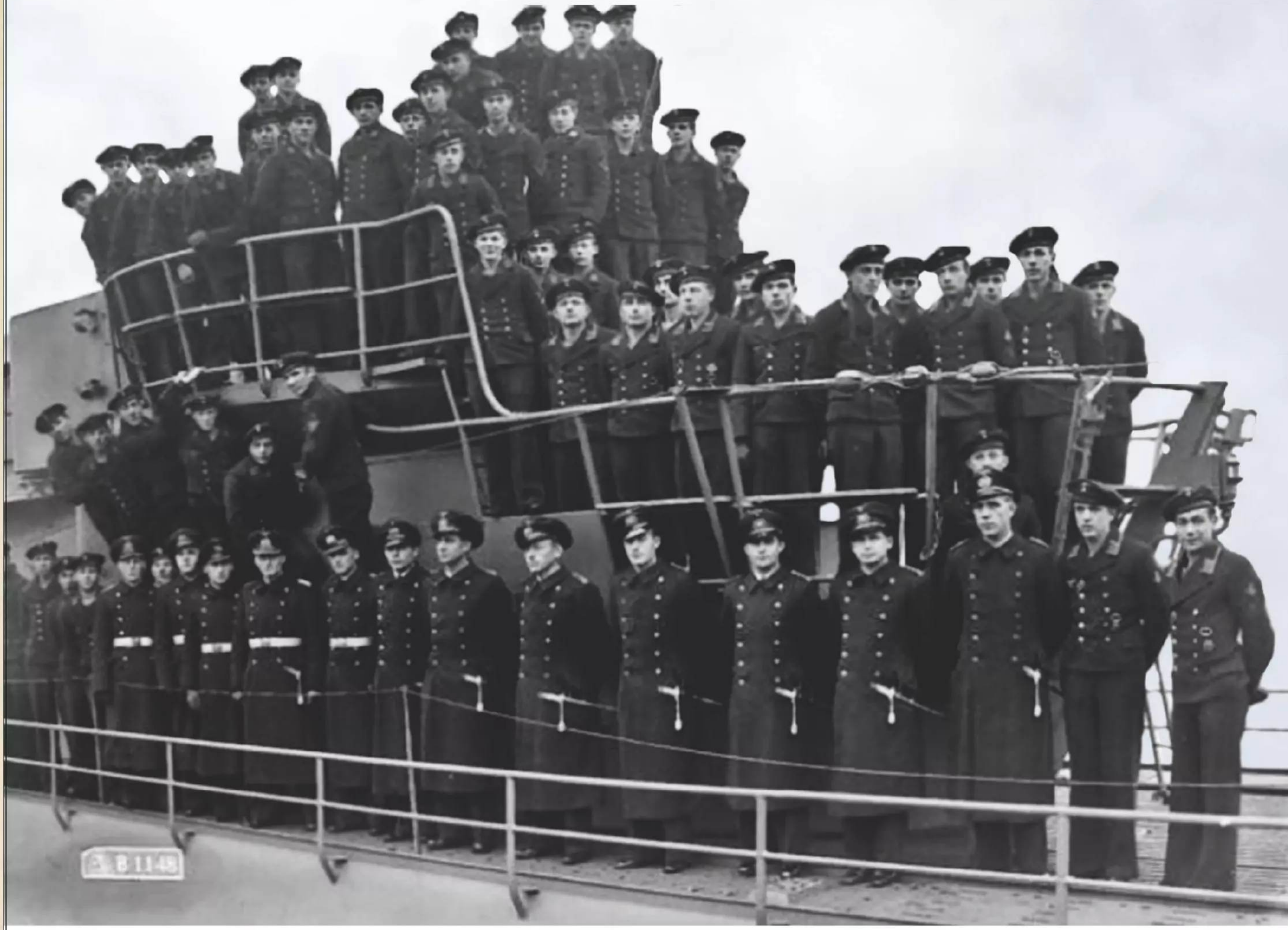
At 09.23 on 9th February, the *Venturer's* hydrophone operator suddenly heard a loud noise in the water and immediately sent a message to duty officer John Watson. The sound was like a fishing boat starting and stopping its engine, but


The hull of the V-class submarine was extended in relation to the previous U-class generation to reduce the noise of its propeller.
HMS Venturer
Deck gun with a calibre of 76 mm.
The bow was more streamlined than previous-generation subs.
Periscopes for use during attacks and for navigation fed down through the tower.
Deck gun with a calibre of 105 mm could be mounted on the front deck.
U-864

FACTS

U-864'S SECRET CARGO

- **Acoustic torpedoes** used microphones and advanced electronics to target an enemy's propellers, even if the vessel changed course.
- **Mercury** for Japan's production of ignition kits in bombs and torpedoes. At least 61 tons of mercury in 1,857 metal bottles sank to the seabed along with the submarine.
- **Radars** that matched British technology, which could remove the US's ability to spring surprise attacks on the Japanese.



The crew of the U-864 stood on the deck in parade uniform when the U-boat was put into service on 9th December, 1943. A year later, the vessel embarked on its first active mission, the crew having spent the preceding time training intensively aboard the sub in the Baltic Sea.

no boats were nearby. On board *U-864*, Captain Wolfram was concerned by the noise the U-boat was emitting. He knew that any noise in the water could be fatal, but the broken engine made it unavoidable. The submarine commander raised his periscope to scout for both enemy vessels and the escort ship, a fateful move as the British happened to also have their periscope up. Launders spotted the German vessel's thin periscope mast as it rose above the waves.

"We felt a bit shaky because it could sink us the same as we could sink them", recalled *Venturer's* torpedo operator Harry Plummer to BBC2's *Timewatch*. The hunt was in progress.

"Bordmutze" side caps were a part of German naval uniforms.

British shadowed the Germans

Aboard the *Venturer* the entire crew remained silent. Launders and Watson pressed the headphones hard against their ears, holding their breath and straining to hear even the weakest sound that the hydrophones might catch.

"We were hoping that she would surface and then if she surfaced we would be able to torpedo her straightaway", Watson remembered.

Launders followed the *U-864* discreetly on a parallel course. The U-boat had six torpedo tubes to the *Venturer's* four, with two firing tubes pointing rearwards. Launders could therefore not risk lying just behind the enemy in case his counterpart suddenly realised he was being shadowed. After following the *U-864* for around an hour, it dawned on the British commander that the submarine was zigzagging to a complicated pattern. Wolfram was obviously aware a hostile vessel might be lying in wait. At regular intervals the British could see Wolfram's periscope pop up to the surface as he scanned for enemy vessels.

"If we ever saw anything of his periscope ... he had a chance to see us, so there's that risk", Watson explained.

Venturer had now followed *U-864* for two hours and Launders was forced to concede that the Germans had no intention of surfacing. No one had previously attempted to torpedo a submerged submarine, but time was running out. At any moment the German U-boat might detect the British, and in that moment the tables would be turned.

Launders could not see his target, and began to calculate furiously. Based on the *U-864's* zigzagging and half-hourly periscope appearances, the Brit managed to discern a pattern to the U-boat's course changes. The captain decided to take a chance and empty all four torpedo tubes. He planned to aim for the position he believed – according to his calculations – that the Germans would occupy when the torpedoes hit.

LAUNDERS WENT ON THE ATTACK

At 12.12 on 9th February, *Venturer* was brought into attack position and a few seconds later, Launders ordered, "Fire number one!" The first torpedo sped through the water at 40 knots, its propellers squealing like a siren. *U-864* was located around 2,000 metres from *Venturer*, and the torpedo would arrive around 90 seconds later. After exactly 17.5 seconds, Launders fired a second torpedo.

Aboard *U-864*, Wolfram's worst fears were realised when the hydrophone operator reported the sound of the torpedo's propellers in the water. He only had one option left. The captain made a bold order, turning the *U-864* directly into the path of the torpedoes to minimise her as a target. He hoped the torpedoes would stream past the sub and its 73-man crew. While the hydrophone operator listened as the deadly torpedoes approached, the giant sub began to slowly turn. Everyone on board knew that their fate would be decided in just a few seconds.

The German hydrophone operator listened as a third torpedo was fired. Shortly after, the first torpedo arrived, but skimmed past the *U-864*. At the same time, Launders fired the fourth and final torpedo before immediately ordering *Venturer* to dive towards the sea bed. The British sub would not be able to reload her tubes before the *U-864* could launch a counterattack, so had to remain hidden. If none of the torpedoes hit, the *Venturer* would be instantly transformed from hunter into prey. The tension was unbearable.

At 12.13, the Germans heard the fourth torpedo being fired. In a desperate attempt to save the crew, Captain Wolfram ordered the submarine to dive, thus sealing the U-boat's fate. Launders had predicted this manoeuvre when he fired his fourth and final torpedo. The missile struck *U-864* amidships.

The blast ripped the U-boat apart and sent the broken sub up on to the sea surface. 12-year-old Christoffer Karlsson was the only witness to the climatic end to the bloody battle under the surface of the sea as he stood on the coast of Fedje:

"There was an explosion, a pretty high jet of water and smoke, and then we saw the U-boat sinking down, quietly, peacefully", he recalled.

At 12.14, Launders wrote in his logbook: "Loud, sharp explosion followed by breaking-up noises".

Hitler's last secret along with 73 German and Japanese men sank to the bottom. Nobody survived.

"If you can imagine a box of matches being squeezed into a hand and cracking up – that is the sound of another ship going down. It breaks up", explained Plummer.

The second that the torpedo hit, the British had won one of World War II's most unique duels. No other submerged vessel has managed to sink another submerged vessel before or since.

"There was a relief", Plummer said. "And then the next minute I realised that it was another submarine and more submariners have been killed ... It was nothing to be jubilant about".

Months later, the Germans attempted to send another sub – *U-234* – to Japan laden with 161 tons of advanced weapons technology. But it was too late. Two months after her departure, Germany surrendered and the sub was ordered to the nearest enemy port to surrender.

Axis powers held together until the last

Nazi Germany and Japan made a firm alliance in the 1930s that lasted until Germany's final capitulation in 1945.

Japan and Germany shared the same military and ideological interests, and cooperation between the countries developed from the mid-1930s through to 1945. Both bound themselves to each other through a series of treaties and agreements.

IDEOLOGY Japan and Germany signed the Anti-Comintern Pact, designed to combat communism in general, and the Soviet Union and Communist International organisation in particular.

SPHERES OF INFLUENCE In 1940 the Tripartite Pact was signed, which gave Germany and Italy the right to establish a "new order" in Europe, and Japan the same right in Asia.

WEAPONS TECHNOLOGY Japan and Germany helped each other through so-called "Yanagi" (Willow) missions where submarines transported raw materials, chemicals and technology.

Japan's Foreign Minister Yosuke Matsuoka travelled to Germany on an official visit in 1941.

Adolf Hitler
Yosuke Matsuoka

The world's only example of the Ho 229 V3 has been in the United States since 1945.

1945

14TH APRIL

INVISIBLE PLANE IS HITLER'S LAST HOPE

In the final months of the war, two German brothers are tasked with building a revolutionary new aircraft that can't be seen by Allied radar. If the plane is finished in time, it might halt the impending German defeat.

Germany, 1945

THE STAGE IS SET

In 1945, the Wehrmacht has its back against the wall. Allied armies are storming into Germany from both east and west, but Hitler refuses to acknowledge defeat and places his trust in new superweapons to reverse the fortunes of war. One such weapon is a state-of-the-art plane that's decades ahead of its time.

GERMANY
Frankfurt

SOLDIERS FROM THE US 3RD ARMY jumped down from the truck and approached the abandoned hangar. In the distance, shots could be heard from the advancing Allied troops and retreating German armies. The hangar stood in a forest in a remote part of central Germany. Reliable intelligence said it was part of a weapons factory that stored one of Hitler's feared "Wunderwaffen" – ground-breaking new weapons that would turn the war back in the Nazis' favour. But now, in mid-April 1945, Hitler's Third Reich was approaching its fall, and the Americans desperately hoped to root out the advanced weapons before other Allied troops. The inventions contained new technology that must not – for the sake of the western world – fall into the hands of the Red Army, who were swarming through Germany from the east.

The Americans pushed the hangar door open, at which point light fell into the room to reveal a wondrous machine. On the floor lay a disassembled plane with such unusual shapes that at first the soldiers didn't understand what they'd found. Although the wings hadn't been mounted, it was clear the machine was completely different to other hunters and bombers. Its shape was reminiscent of a bat. When the smooth grey-green plane with painted Swastikas was assembled, it was one large wing that ended in a slight tip. The plane had no propellers; instead, two jet engines of a brand new and hyper-advanced type were embedded in the fuselage on either side of the one-man cockpit. There was no doubt in the American's minds: they really were looking at one of Hitler's superweapons. After checking the Allied list of wunderwaffen, it soon became clear that the plane discovered in this deserted hangar in the forest was the legendary "invisible" Ho 229 jet fighter.

Luftwaffe eagles had the wing tips pointing up to differentiate them from army and navy badges.

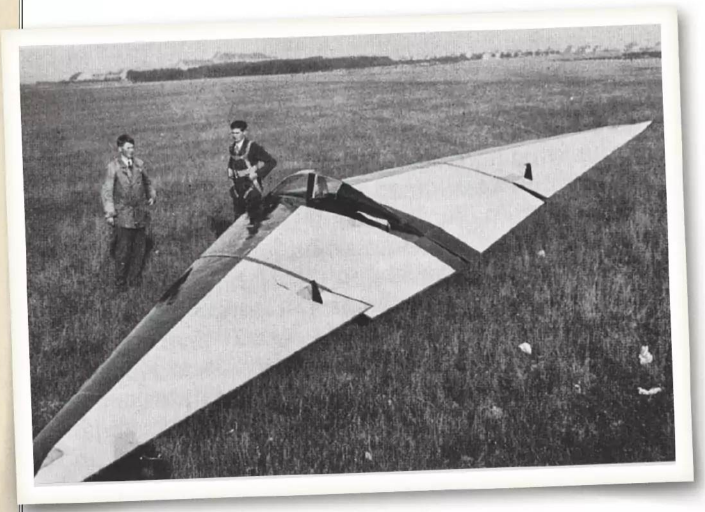
GERMANS BUILT GLIDER

The men behind the unique machine were German brothers Reimar and Walter Horten. The boys had been obsessed with aircraft from childhood and did all they could to absorb as much knowledge about planes as possible. Their long experience constructing both model aircraft and gliders was pivotal during the development of the Ho 229 stealth fighter.

During their adolescence, the brothers repeatedly entered Germany's national model aircraft championships with their own home-built models. The Treaty of Versailles had blocked the construction of motorised and armoured aircraft in Germany, and so the glider became popular in interwar Germany.

From 1925, the Hortens began building models from wood and plywood. The technically gifted Reimar was particularly absorbed by a single-wing design. This design – better known as a flying wing – has no tail section; instead both wings and body go out as one. The design required intricate mathematical calculations for everything from buoyancy to landing. As the brothers gained more experience, their flying wings became better and more stable and could soon fly further than the competition's conventional designs. The brothers won first place three years running from 1930-32 at the championships, which took place on Wasserkuppe mountain near Frankfurt.

Success gave them hunger for more, and in 1932 17-year-old Reimar and 19-year-old Walter decided it was time to build a full-size flying wing with them as pilots. The plane was named Ho I and was completed in 1933. In the summer of 1934 the brothers proudly headed to the glider championships where they collected 600 Reichsmarks for the most innovative design. But problems getting the plane home forced them to burn all but the most valuable metal parts. Reimar announced he would build a new model as soon as possible – this one with a motor, and received permission from Hitler, despite it contravening the Treaty of Versailles. As with Ho I, Ho II was built at the



Reimar and Walter Horten's first glider was completed in 1933 and was named Ho I.

Reimar family home in Bonn. People passing the house on the Venusbergweg must have wondered what was going on when – for example – a wing stuck out of one of the windows. For the plane to leave the building, the double doors to the living room had to be removed while the wings scraped across the parquet floor. Despite the wear and tear on their home, Max and Elizabeth Horten fully supported their sons' project.

By the time Ho II had been completed in May 1935, it was too late for the brothers to sign up for that year's championships. At the same time, both men were conscripted to the Nazi regime's mandatory two years of military service. While Walter became a fighter pilot, Reimar performed his military service as a flight instructor at the Luftwaffe's based in Cologne. But what initially looked like a setback for their development work soon became a huge opportunity. The base received a new commander, Major Oskar Dinort, who was passionate about gliders and had set the world record for the longest flight with 14 hours and 43 minutes on the wing. As soon as Dinort saw Reimar's aerodynamic Ho II, he wanted one, and several other officers also placed orders. Soon Reimar was given his own workshop at the airfield, where he also developed new motorised models.

The small planes were built from wood and light metals, using less fuel to allow them to fly longer than conventional types of plane. The brothers' work started to receive serious attention from experts, and in 1938 Reimar and Walter received the Lilienthal Prize for Innovative Design along with 5,000 Reichsmarks. The money made it possible for them to finance one year's aviation studies at the Technical University of Berlin.

BROTHERS CREATED A FAKE SPECIAL UNIT

In 1939, the Nazis invaded Poland. World War II was underway, and both brothers were called up to the Luftwaffe. But Walter was shrewd and quickly found a loophole in the German military machine to allow them to continue uninterrupted development with a fake top-secret project, Sonerkommando L In 3. Walter used all his charm to persuade a secretary – whom he later married – in the German aviation ministry to forge her boss's signature so Reimar could be transferred to the working group.

Sonderkommando L In 3 provided a cover for Reimar's workshop where he could – among other things – experiment with designing aircraft that were invisible

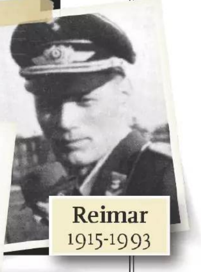
NAME **WALTER & REIMAR HORTEN**

TITLE AIRCRAFT DESIGNERS

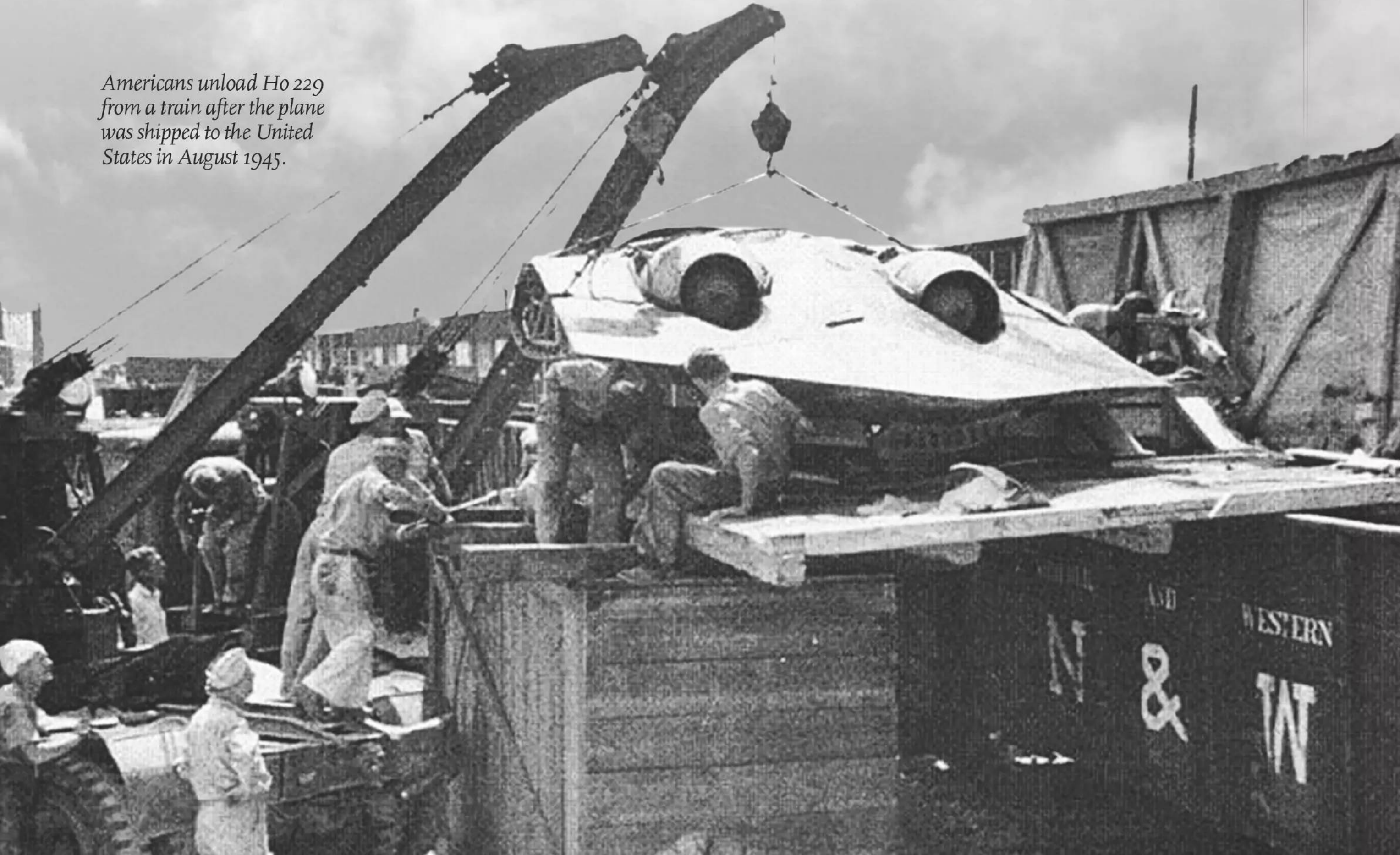
Flying wing led brothers to success

Despite no formal training in aviation engineering, brothers Walter and Reimar Horten managed to develop some of the most advanced planes in the 1940s. One of the reasons for their success was the fact they didn't use the conventional designs favoured in the 1920s and 1930s. Instead, their developmental work was based on a single-wing design – a form they'd worked with since becoming members of a flying club in 1925.

- **Both joined the Hitler Youth.**
- **Members of the Nazi party.**


Reimar
1915-1993

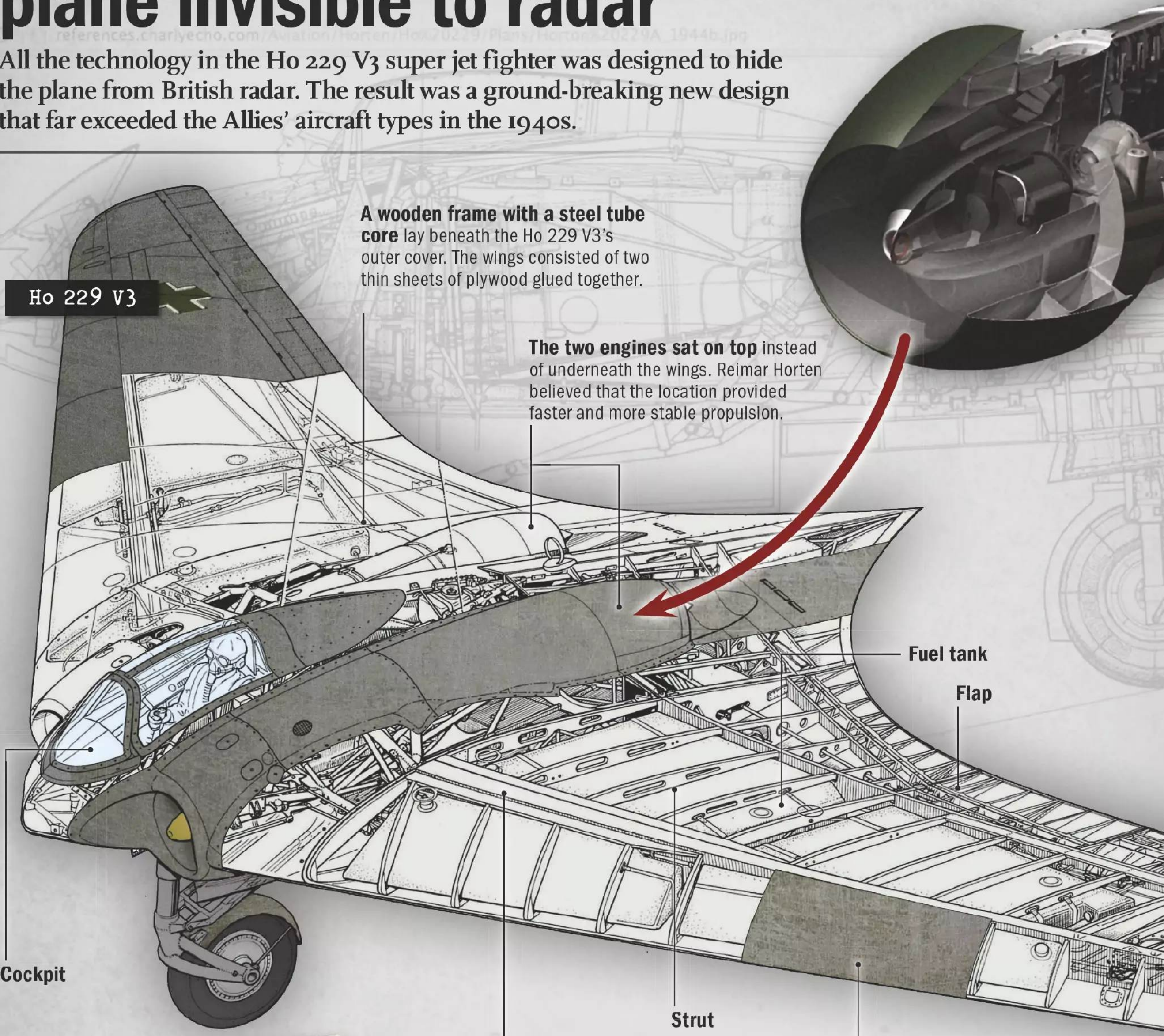
Walter
1913-1998


Americans unload Ho 229 from a train after the plane was shipped to the United States in August 1945.

PLANE

Wing form and paint made plane invisible to radar

All the technology in the Ho 229 V3 super jet fighter was designed to hide the plane from British radar. The result was a ground-breaking new design that far exceeded the Allies' aircraft types in the 1940s.

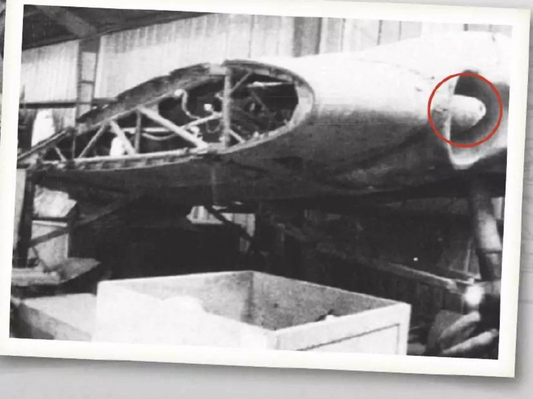


A wooden frame with a steel tube core lay beneath the Ho 229 V3's outer cover. The wings consisted of two thin sheets of plywood glued together.

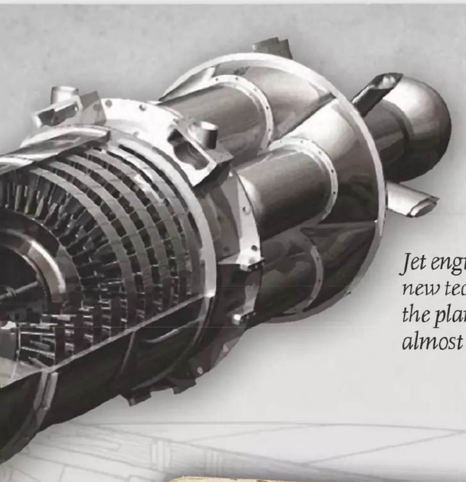
The two engines sat on top instead of underneath the wings. Reimar Horten believed that the location provided faster and more stable propulsion.

Coal dust and sawdust mixture was painted on the surface of the aircraft to absorb radar waves so that the plane's inner metal parts didn't reflect the waves back to the station.

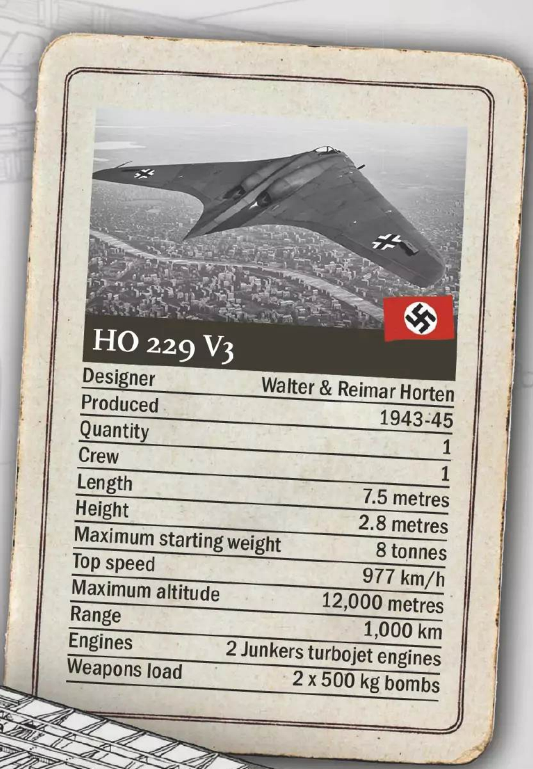
The pilot wore a pressure helmet due to the high altitude.



The jet engines were located between the cockpit and the detachable wing.

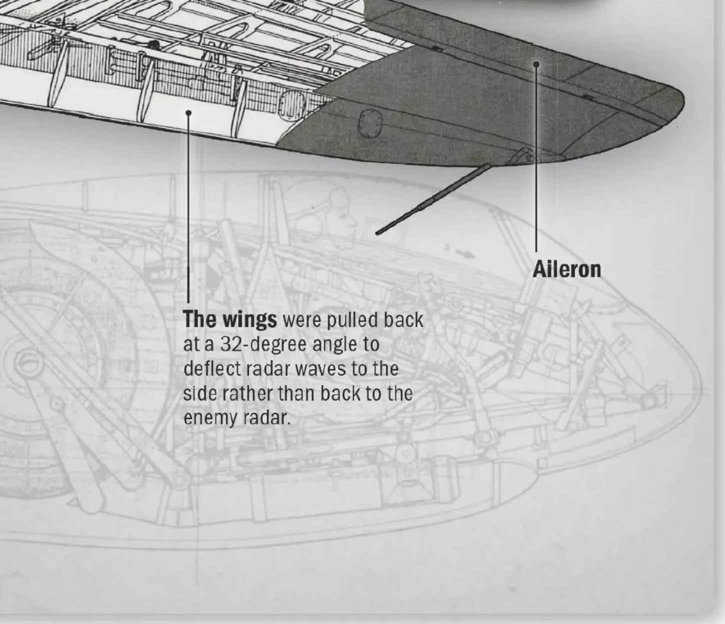


Jet engines were a whole new technology and gave the plane a top speed of almost 1,000 km/h.



HO 229 V3

Designer	Walter & Reimar Horten
Produced	1943-45
Quantity	1
Crew	1
Length	7.5 metres
Height	2.8 metres
Maximum starting weight	8 tonnes
Top speed	977 km/h
Maximum altitude	12,000 metres
Range	1,000 km
Engines	2 Junkers turbojet engines
Weapons load	2 x 500 kg bombs



The wings were pulled back at a 32-degree angle to deflect radar waves to the side rather than back to the enemy radar.

Luftwaffe mechanics wore a black oblique cap, which was also used by air defence personnel.

to enemy radar. The younger Horten combined a flying-wing design with a radar-absorbing coat of glue mixed with coal dust to create the world's first stealth plane.

The brothers continued the scam and ordered materials to their home using several forged signatures. "If the Air Ministry had found out about our prior activities, we could have been in very difficult times", Reimar later confessed, but despite the threat of a harsh prison sentence, Walter deemed that Reimar's work carried greater weight.

The enemy's new radar technology had proved its worth during the Battle of Britain from July to October 1940. Walter had watched as one good pilot colleague after another had been shot down thanks to the RAF's efficient Chain Home early-warning system. In addition, the German fighter Messerschmitt Bf 109 had proved less agile than the British Spitfire. Reimar had to construct a superior German fighter plane, one both twice as fast as a Spitfire and difficult for the British radar system to detect.

BROTHERS IMPRESSED GÖRING

Thanks to a stroke of luck, Walter had been transferred from active fighter pilot to technical advisor in the newly created Jagdfluginspektion (Fighter Inspection Command). Here he became acquainted with a new advanced technology: jet engines. The engines, which had been developed by BMW and Junkers, would be part of a new generation of German fighters. Walter realised that propellers would soon be obsolete when he saw the sketches of the Messerschmitt Me 262 turbo jet fighter and later attended the first test flight of the tailless rocket-powered Lippisch DFS 194 aircraft.

Walter used fake signatures to order jet engines and gather a 170-man working group for the fictional Sonderkommando L In 3. In order to make the project look official, his brother always appeared in official Luftwaffe uniform.

In mid-1943, as Reimar was working on the brothers' most advanced project yet, a single-wing turbo jet, Hermann Göring issued a call to the Nazi airline industry. The Luftwaffe boss demanded that a fighter plane be developed that could be loaded with 1,000-kg bombs and fly 1,000 kilometres with a top speed of 1,000 km/h. The Horten brothers didn't hesitate and immediately submitted their new project entitled Ho 229.

After a few weeks, the call came to meet at Göring's country house Carinhall, north-east of Berlin. As Reimar presented his sketches, Göring's eye widened – particularly when he realised that Reimer's flying wing was the only one of those proposals submitted that came close to fulfilling his brief.

At the end of the meeting, Göring got up excitedly: "Do it. Make it and let me see it".

With Göring's support, Ho 229 went from a dubious backyard project to a high-profile superweapon designed to save the Third Reich. Ho 229 was to be built at the Gothaer Waggonfabrik aircraft factory, but with Germany pushed back on both fronts and a substantial lack of materials, the project was little more than a pipe dream. Nevertheless, Reimar worked day and night, even as the Americans crossed the Rhine in the spring of 1945 and British planes bombed German cities.

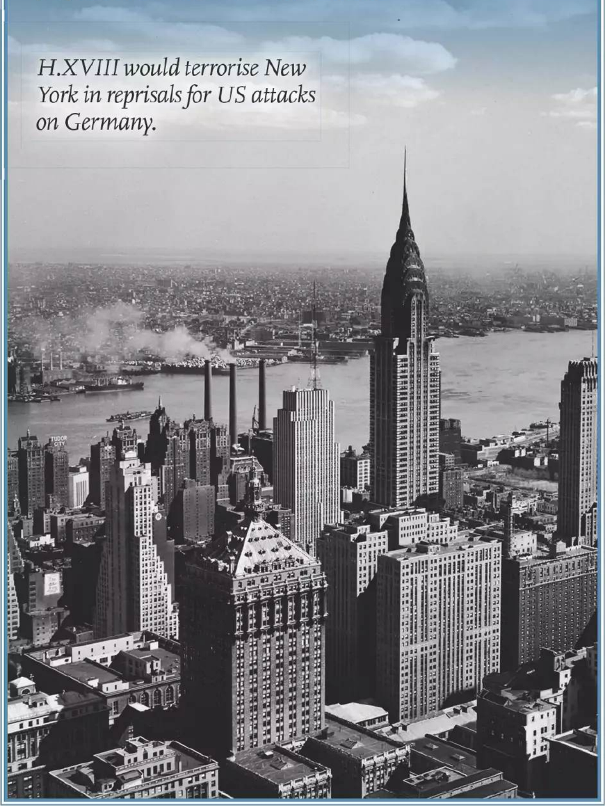
His calculations and test flights allowed Reimar to discover that the jet engines should sit on the top of the wing for maximum effect. He also had to adapt the cranks, brakes and flaps to the powerful engines, otherwise the flying wing risked the dreaded "Dutch roll", a movement whereby the plane would rock uncontrollably from side to side. Although the super plane was expected to roll out in six months, due to problems with the engines that were 12 centimetres too long, the project fell behind schedule. It wasn't until 18th December, 1944 that Ho 229 – the world's first jet-powered single-wing fighter – went into the air. A proud Reimar Horten watched his unique plane from the ground.

"Amerika bombs" would strike United States

Build a plane to reach New York, drop four tonnes of bombs and return to Germany. These were the demands of the German Amerika Bomber project.

From 1942, the Germans tried to develop a plane or rocket that had a range of 11,000 kilometres. The aircraft would be able to reach the United States with a bomb load of four tonnes and then return safely to Germany.

Reich Minister of Aviation Hermann Göring also invited the Horten brothers to contribute to the work, called the Amerika Bomber project. The visionary brothers drew up the single-wing H.XVIII bomber. The plane was based on the Ho 229 jet fighter, but was much larger with a wing span of 40 metres and powered by six jet engines. H.XVIII also possessed stealth features and would only been seen on radar screens when 20 kilometres from the US coast. The bomber, like all other Amerika Bomber projects, was never realised, however.



H.XVIII would terrorise New York in reprisals for US attacks on Germany.

The Ho 229's success reached high up in Nazi circles and triggered a new meeting with Göring. They met several times and the Luftwaffe chief became increasingly spellbound by the brothers' work as their relationship became increasingly familiar. "It was like a speech from a father to a son", Reimar recounted about Göring's comments later.

During one of the meetings, Göring asked what Reimar wanted to do after the war: "I told him I will go to Freiburg and... I will develop planes there", the younger Horten recalled later. "Göring answered: 'I will need one hangar for Lufthansa'. He meant that he agreed that he would give me all the hangars there except one to make sailplanes and carry out design work".

TEST PILOT WAS FLUNG FROM PLANE

The Horten brothers' lifelong project was close to success when disaster struck. In February 1945, during the test flight of the second version of the flying-wing plane, one engine cut out. The pilot extended the landing gear too soon, disrupting the plane's balance. To the horror of those watching, the unique plane went into a series of spins before smashing into the ground while the pilot was thrown from the cockpit into some fruit trees. When help arrived, he was found dead among the trees' branches.

The crash forced the Horten brothers to build a new prototype from scratch. But although Reimar and Walter burned for the cause, they recognised in March 1945 that Germany was close to defeat. Their new, improved prototype – Ho 229 V3 – would never be completed, even though the factory was working at full stretch.

On 14th April, 1945, it was finally all over. US soldiers stormed the secret hangar and shortly after Reimar and Walter Horten were sent – with other German engineers and scientists – to Britain for interrogation. But initial excitement faded quickly. The experts leading the brothers' interrogation simply didn't understand the flying-wing design. The incomplete aircraft was, however, shipped to the US where it would be assembled and examined.

After their release, Reimar and Walter briefly worked for the British. The idea was to build flying wing planes that could be used for passenger flights on intercontinental routes, but the project was quickly shelved in 1946. Walter then returned to Germany until his death in 1998, while Reimar emigrated to Argentina in 1949 where the country's dictator Juan Perón offered well-paid work to German engineers and weapons experts.

The Hortens' flying wings were decades ahead of their time. The US only really realised the potential of stealth technology with the B-2 Spirit bomber in 1988, which boasted many similarities to the Ho 229 V3. After a lifetime in obscurity, Reimar Horten finally gained full recognition for his work in 1993 when the Royal Aeronautical Society awarded him a Gold Medal for his outstanding efforts.

Ho 229 laid the foundations for today's stealth planes

Modern stealth aircraft use a special coating and shape that prevents radar waves from detecting the planes, just like the Horten brothers' superweapon. Today, the technology is employed by Russia, China and the United States.

The Chinese demonstrated a prototype of Shenyang J-31 at an aerospace exhibition in China in 2014.

Doubts of Chinese invisibility

China is currently developing the stealth fighter Shenyang J-31. The plane is believed to be able to brush off several types of radar wave, but aviation experts outside China are uncertain about what gives the fighter its stealth properties. Like the Ho 229, it may simply be a surface coating. The plane's top speed is 2,200 km/h. Its total weight is 17,600 kilograms.

The Sukhoi Su-57 flies under the radar at over 2,000 km/h.

Russians test stealth fighter

Russia is in the final stages of testing the country's first stealth aircraft – the Sukhoi Su-57 (prototype name T-50). Its stealth features are based on the plane's shape and angles. In addition, the antennae are recessed and its weapons – machine guns and missiles – are placed inside the aircraft so radar can't detect them. Finally, Sukhoi has been treated with radar-absorbent material (RAM), which reduces the reflective ability of radar waves.

The fighter plane has a top speed of 2,440 km/h, a range of 3,500 kilometres (without refuelling in the air) and a maximum altitude of 20 kilometres. Armaments consist of a total of 30 missiles.

Stealth plane shot down

A total of 64 US F-117 Nighthawk aircraft were used during several wars, including in Iraq in 1991 and 2003, Afghanistan in 2001 and Yugoslavia in 1999. The Yugoslavs got lucky and shot down a Nighthawk with ground-to-air missiles because their radar detected the plane's open bomb hatches. The pilot ejected and was rescued around eight hours later.

In 2008, the Nighthawk was retired after 25 years of service in the US Air Force.

Despite its stealth properties, a Nighthawk was shot down by a missile over Yugoslavia in 1999.

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